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ELMER DREW MERRILL

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ONE PLATE

Elmer Drew Merrill, botanist and former Director of the Bureau of Science, died after a lingering illness in Jamaica Plain, Massachusetts, on February 25, 1956. He was seventy-nine years old. Dr. Merrill will be missed by his colleagues, associates, and friends in the National Museum, Institute of Science and Technology (formerly Bureau of Science), in the University of the Philippines, and in other institutions with which he was connected for twenty-two years. In the death of one of the world's leading botanists, the scientific world sustained a great loss.

Dr. Merrill came to the Philippines in March, 1902. He reported for duty at the Bureau of Agriculture upon his arrival in the Philippines. A few months after his arrival, he was appointed botanist of the Bureau of Forestry, dividing his time between the Bureau of Agriculture and the Bureau of Forestry. In January, 1903, he was transferred to the then Bureau of Government Laboratories on Calle Iris, which in 1906 became the Bureau of Science. He organized the famous Bureau of Science Herbarium in 1906. He became Acting Director of the Bureau of Science on July 1, 1919, and was appointed Director a few months later. He continued as Director until 1923, when he retired. Before his death, he was considered the living Linnæus. He was the authority on the Flora of the Philippines, and also on the Flora of Indo-Malaysia.

Dr. Merrill was born in East Auburn, a suburb of Auburn, Maine, on October 15, 1876. In the fall of 1894 he entered

the freshman class of the Maine State College at Orono, an institution that, in his senior year in 1898, became the University of Maine. He elected to take the general science course, and was graduated with a Bachelor of Science degree in June, 1898, as valedictorian of the class, and with a Master of Science in 1904. In college he became a Charter Member of Phi Kappa Sigma, Phi Kappa Phi, and Sigma Xi. He was elected to the Phi Beta Kappa. In 1926 he was conferred an honorary degree, Doctor of Science, by the University of Maine; and in 1936, Doctor of Laws, by the University of California; and Doctor of Science, by Harvard University. He was a recipient in 1939 of the Linnaean Gold Medal by the Linnaean Society of London, and Medaille d'Or awarded by the Societe Nationale d'Acclimatation.

In college he showed much interest in biological work especially in botany and particularly in the classification of flowering plants. He had not taken formal graduate work; but he may be considered to be self-trained in botany. During his entire college career he collected extensively and when he left Maine, he had a private herbarium in excess of 2,000 named specimens which he later on presented to the New England Botanical Club. Since he came to the Philippines and until he died he did not possess a private herbarium. In every institution he served, the Bureau of Science, University of California, New York Botanical Garden and Arnold Arboretum of Harvard University, he accumulated tremendous collections of plants and left them at these institutions. I inherited from him, when I took over the herbarium at the Bureau of Science, over 275,000 mounted sheets. He could have died a rich man, had he built a private herbarium of his own. He was honest to the core.

On September, 1898, he returned to the University of Maine as assistant in natural science at a salary of $250 for nine months' work. In July, 1899 he accepted a fellowship for a year at the Geneva (New York) Experiment Station to work in plant pathology. Later he received an appointment as assistant agrostologist in the United States National Herbarium in Washington and reported for work on July 7, 1899. His work in Washington, where he was an assistant to L. Lamson-Scribner, was on taxonomy of the North American Gramineæ. He gained there a knowledge of herbarium methods. His training for two and one-half years served him excellent

for the infinitely more complex and difficult task that was to come later in the Philippines.

In 1900 to 1901, he entered the George Washington University Medical School where he completed the first year's work and the first semester of the second year. An event occurred during his stay in this school that definitely made him to devote his career in the botanical field.

On February 20, 1902, he was offered the position of botanist in the Philippine Bureau of Agriculture by Dr. F. Lamson-Scribner, the first director of this bureau. He sailed for Manila on February 22, 1902, on the U.S. Army Transport "McClellan," which sailed via Suez, reaching Manila the following March.

In Manila he first lived at 155 Nozaleda Street, headquarters for the newly arrived personnel of the Bureau of Agriculture. He commenced his work without a chair or table, much less a botanical publication or a botanical specimen. In surveying the field, he found that the botanical collections assembled by Sebastian Vidal y Soler from 1876 to 1888 together with the entire botanical library was destroyed by fire in the burning of the offices of the Inspección de Montes in 1897. The small but important collection of botanical literature at the Jardin Botanico at Manila, then operated as a small city park, disappeared in the unsettled period contingent on the American occupation of Manila. Dr. Merrill acquired a small set of Vidal's plants from Kew Herbarium, London, but this was destroyed during the liberation of Manila in February, 1945. The botanical specimens assembled by Fernandez-Villar for the third edition of Blanco's *Flora de Filipinas,* stored at the Guadalupe Convent on the Pasig River, was destroyed when this building was burned by the American troops in 1899. It was truly a most discouraging outlook for the most enthusiastic botanist.

The Bureau of Forestry under Captain George P. Ahern had assembled a little botanical literature and some botanical materials, for the most part unnamed or only partly named. Dr. Merrill began his botanical field work by collecting representatives of all the weeds in the backyard of his "office building." That was the beginning of the large and important collections that were to be assembled during the next two decades of his stay in the Philippines.

The centralization in one institution of all scientific work in the Philippines was then conceived by Dean C. Worcester and resulted in the establishment in 1901 of the Bureau of Government Laboratories, which in 1906 became the Bureau of Science. Dr. Merrill, a few months after his arrival, divided his time between the Bureau of Agriculture and the Bureau of Forestry. In 1903 he was transferred to the Bureau of Government Laboratories with offices in a ramshackle building on Iris Street.

Dr. Merrill started his first field trip one month after his arrival, covering the Caraballo Sur mountain to Nueva Vizcaya, to Quiangan and then to Cagayan River under military guard. During his twenty-two years' stay, he travelled practically all parts of the Philippines.

In September, 1902, Dr. Merrill went to Bogor (Buitenzorg) with a set of botanical materials for identification. He had then no authentically named material for purposes of comparison and very little of the essential literature.

Dr. Merrill realized that no thorough work on the Flora of the Philippines could be done on the basis of Philippine material alone. He conducted exchanges with botanical institutions in Japan, Formosa, China, India, Singapore, Java, and Australia, with more important botanical institutions in Europe and, to a lesser degree, with American institutions. The staff members of the Bureau carried on extensive field work in Southeastern China, Indo-China, Borneo, Amboina, and the Marianas Islands.

Dr. Merrill left in 1922 a valuable reference collection of over 275,000 mounted specimens of which about two-thirds were Philippines and one-third were from botanically related regions. Dr. Merrill during this time sent in exchange probably in excess of 500,000 duplicates. This was a very wise and fortunate policy of Dr. Merrill. When I joined the Bureau of Science in 1928, I continued this wise policy. Had it not been for this policy in distributing these Philippine materials, it would be impossible for anyone to study and write on the Flora of the Philippines, as the Herbarium * of the Bureau of Science was completely destroyed by the Japanese during the liberation of Manila in February, 1945, as was its entire botanical library.

* As of June, 1940, the Philippine National Herbarium (former Bureau of Science Herbarium) had about 305,367 mounted specimens.

It is such rich collection as the above, which contained representatives of practically all species known from the Archipelago, which I inherited from Dr. Merrill. It contained several thousands of types, isotypes, fragments of types, topotypes, and materials critically compared with types, photographs of types, sketches, and carbon rubbings. When he retired, I inherited also one of the most complete collections of botanical literature in all Asia and Malaysia. In addition to the amount annually allotted for purchase of books and journals, he bartered botanical specimens with publications.

I continued the policy of Dr. Merrill of enlisting the services of specialists without cost to the Philippine Government. Duplicate materials were supplied freely to any botanist who was in a position to make determinations in a group. His dealings were almost entirely with European botanists as there were very few Americans who had interest in Philippine flora.

Dr. Merrill's botanical work was interrupted during 1912 to 1919, when he was appointed part-time Professor of Botany in the University of the Philippines. He continued teaching at the University of the Philippines as Professional Lecturer from 1919 to 1923. This teaching assignment seriously interrupted his productive work in systematic botany.

On July 1, 1909, his botanical work suffered also interruption when he was appointed Acting Director of the Bureau of Science for a few months, and became its Director until 1923 when he retired. It was during his directorship of the Bureau of Science when he particularly thought of preparing and publishing a general descriptive Flora of the Philippines. I observed that he did his botanical work outside of office hours and on Sundays and holidays, as most of his official time was consumed in administrative duties as Director. While he accepted his new assignment with diffidence and with reluctance, he found the years following not only deeply interesting but also useful in giving him a most liberal education in reference to problems outside of his chosen field.

As Director of the Bureau of Science he amplified the facilities of the Serum Laboratory and introduced various innovations. The Philippine Journal of Science was established in 1906 at the suggestion of Dr. Merrill. The Botanical Section of the Philippine Journal of Science was established in 1907, and was maintained until 1918, when the sections were aban-

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doned and beginning in 1919 all the papers were printed in a single series.

Dr. Merrill from 1899 to 1902, before coming to the Philippines, published about 25 papers mostly on grasses. From 1903 to 1946, he published no less than 478 papers. Before his death this must have reached no less than 500. He contributed numerous papers on the floras of the Philippines, Amboina, Guam, Borneo, China, Indo-China, New Guinea, Sumatra, Solomon Islands, Burma, and Fiji. The papers and reprints published by Dr. Merrill between 1899 and 1930 form a series of twenty-one volumes, averaging about 500 pages to the volume. A list of published works of Dr. Merrill from 1899 to 1946 appeared in "Merrilliana," Chronica Botanica **10** (1946) 138–157. The private library of Dr. Merrill was donated to the New York Botanical Garden.

Dr. Merrill had to terminate his valuable services in the Philippines in 1923, but continued his interest on the Philippine Flora up to 1949, while in Arnold Arboretum. He was a great help in the rehabilitation of the Philippine National Herbarium (formerly Bureau of Science Herbarium). Right after liberation in 1946, he gave us a grant of $1,000 to help us in collecting trips. He helped us identify thousands of our plants now in the herbarium.

He reported for duty at the University of California but did not start work until January, 1924, as Dean of the College of Agriculture. In July, 1924, in addition to his duties as Dean, he was made Director of the Agricultural Experiment Station. In 1925 he established the technical periodical "Hilgardia" as an official publication of the Experiment Station.

During his six years' stay in the University of California, he devoted all his spare time to actual work in systematic botany. He built up an oriental reference herbarium in the University with over 110,000 mounted specimens. He did this work outside of office hours; early in the morning before his own office opened, at noon, (he took his lunch in the herbarium), after office hours or on Sundays and holidays. In addition he became the Director of the California Botanical Garden, Los Angeles, in 1927 to 1928.

It was a great pleasure and privilege to work again with Dr. Merrill in the University of California, Berkeley, in 1926 to 1928. He secured for me a fellowship of the National Research Council of the United States, a rare privilege afforded

to a Filipino. This ripened our close association. I met him in the Bureau of Science way back in 1915 when I was a student at the Philippine College of Agriculture. I used to come to the Bureau of Science to identify my plants for the Los Baños Herbarium, and this continued practically every Saturday and Sunday, except during 1920 to 1923 while I was at the University of Chicago.

On January 2, 1930, Dr. Merrill became the Director-in-Chief of the New York Botanical Garden. He established "Brittonia," in 1931. He stayed here only until 1935, as he accepted a far more responsible position in Harvard University as Arnold Professor of Botany and Administrator of Botanical collections and Director of the Arnold Arboretum until he retired on July 31, 1946. He established in 1941 "Arnoldia" and in 1942, "Sargentea." After retirement he continued working at the Arnold Arboretum until about 1949 when he finally had to stop due to ill health. He continued his work, however, in his house until his death.

Dr. Merrill contributed most on the improvement of herbarium methods, which had to a very large degree, everywhere become static. He introduced innovations when he was in Manila, continued these at Berkeley, and continued his work to its climax when he was the Director of Arnold Arboretum. He introduced the colored scheme of the genus covers. He incorporated original descriptions on the sheets in juxta-position with herbarium specimens attached on the sheets or the species covers critical notes, photographs of the types, carbon rubbings of types or authentic specimens, photostat copies of illustrations; dissections of flowers in pockets; and even original sketches of dissected flower parts, etc. He had, therefore, the herbarium and the library references in one.

Dr. Merrill received many honors and was member of many scientific societies. He was Corresponding Member, Malayan Branch, Royal Asiatic Society, Singapore, 1919; Member, National Academy of Science, Washington, D.C., 1923; Correspondent, Museum National d'Historie Naturelle, Paris, 1924; Correspondent, Naturhistorisches Museum, Vienna, 1924; Corresponding Member, Deutsche Botanische Gessellschaft, 1925; Corresponding Member, Peking Society of Natural History, 1929; Acting President, American Association for the Advancement of Science meeting, December, 1931; Member, Latin American Committee of Selection, Guggenheim Foundation,

1931; Trustee, Horticultural Society of New York, 1931–1935; Member, American Philosophical Society, 1932; Advisory Editor, Chronica Botanica, 1938; Honorary Member, Japanese Botanical Society, 1936; President, New England Botanical Club, 1937; Academico Honorario, Universidad Nacional de la Plata, 1937; Honorary Member, Kon. Nederlandsch Aardrikijkskundiz, Genoostschap, 1938; Corresponding Member, Institut Genevois, 1939; Associate Member, Museum National d'Historie Naturelle, Paris, 1940; President, Fairchild Tropical Garden, 1940; Honorary Member, Royal Agricultural and Horticultural Society of India, 1941; Consultant to the Secretary of War, U. S. A., 1943 to 1945; Vice-President, International Council of Scientific Unions, 1945; Correspondent, Academie des Sciences de l'Institut de France, 1945; Honorary Foreign Member, Edinburgh Botanical Society, 1946; Honorary Foreign Member, Kunglsvenska Vetenskapsakademien, 1946; Member, Advisory Scientific Board, Gorgas Memorial Institute, 1946; Member, Board of Directors, Escuela Agricola Panamericana, 1946; Honorary Fellow, Royal Society of Edinburgh, 1946.

I had the fortune of meeting again Dr. Merrill in August to the end of September in 1954, when I was in Harvard University. I worked at the Arnold Arboretum, Jamaica Plains, for two weeks and the rest of the time until October 7, 1954, at Cambridge. I used to see him every Saturday until I left. When I first saw him he was able to negotiate the stairs; but towards the latter part of September he had transferred to his library in the ground floor. To his last days he was putting the finishing touches to his last contribution to science. His latest classical publication was, "The Botany of Cook's Voyages" in Chronica Botanica 14 (1954) 161–384.

Dr. Merrill married Mary Augusta Sperry of Illinois in Manila in May, 1907. The day following their marriage the couple went to the United States. Dr. Merrill spent two months in London (Kew and the British Museum), Leiden (Rijks Herbarium), Berlin, Geneva and Florence to examine types of Philippine species. They returned in April, 1908. The children of this marriage were Lynne, born in Manila on February 12, 1909; Dudley Sperry, born in Manila on September 21, 1912; Wilmans Noyes, born in Manila on December 21, 1914 (died February 3, 1915); and Ann, born in Washington, D.C. on August 8, 1916.

PROTEOLYTIC ENZYME FROM A PHILIPPINE STRAIN OF ASPERGILLUS ORYZÆ (AHLBURG) COHN.[1]

By LUZ BAENS-ARCEGA, JOAQUIN MARAÑON, and MACARIO A. PALO
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TWO PLATES

Molds, bacteria and yeasts of fermentation industries are remarkable for their ability to elaborate a wide variety of enzymes, biochemical catalysts, which dissimilate organic substances into various derivatives of great usefulness and economic importance. Tauber(5) enumerates 23 different enzymes elaborated by *Aspergillus oryzæ* (Ahlburg) Cohn. and 20 by *Aspergillus niger* Van Tieghem. Prescott and Dunn(4) cite the industrial application of members of the *Aspergillus flavus-oryzæ* group especially strains of *A. oryzæ* which are extensively used in Japan in the manufacture of *shoyu* (soy sauce), *miso*, a soybean product, *mizaume*, a sugar syrup prepared from rice, and *sake* and other alcoholic liquors. These molds are also used in the manufacture of commercial enzymes such as Takadiastase, Polyzyme, Digestin, Oryzyme, and Kasiwagidiastase.

This investigation was undertaken to isolate from our rich mold microflora, yellow-green species with high efficiency for producing protease which can be used for preparing bates for the tanning industry and for hydrolyzing fish, animal and vegetable proteins into food appetizers. Our main interest was focused on protease, which according to the findings of Oshima and Church,(3) who have studied extensively this enzyme from various species and strains of the *A. flavus-oryzæ* group, is produced in highest quantity by a type of *Aspergillus effusus* Tiraboschi.

EXPERIMENTAL PROCEDURE

Isolation of the mold.—Sterilized Petri dishes containing steamed rice were exposed for 15 minutes at different places within the Institute of Science and Technology compound to catch some air-borne mold spores. After 3 days of incubation

[1] A progress report of this study was read before the First Annual Convention of the Philippine Association for the Advancement of Science, Manila, October 27, 1951.

at room temperature (28 to 30° C), yellow-green fungi which grew on the rice were isolated by touching with a moistened tip of a fine inoculating needle mature sporeheads and then transferring the spores that stuck to the needle into a test tube of Czapek's agar slant. The isolates were plated out on Czapek's agar and observed for uniformity of colonies and similarity of appearance and color of growth.

Selection of culture medium for enzyme production.—In view of the unavailability of wheat bran, a culture medium used by previous investigators in preparing enzyme from molds, rice bran [2] and copra meal,[3] both cheap local farm by-products, were used in this study. In proximate chemical composition (Table 1) copra meal has the highest protein content (27.60 per cent), followed by rice bran (17.94 per cent), and by wheat bran (16.66 per cent).

TABLE 1.—*Composition of wheat bran, rice bran, and copra meal.*

Constituent	Wheat bran		Rice bran		Copra meal	
	By analysis [a]	Moisture free basis (computed)	By analysis [b]	Moisture free basis (computed)	By analysis [b]	Moisture free basis (computed)
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Moisture	10.91		5.80		6.90	
Fat	5.03	5.65	19.80	21.02	6.90	7.41
Protein	14.84	16.66	16.90	17.94	25.70	27.60
Ash	5.59	6.27	10.50	11.15	7.70	8.27
Crude fiber	5.98	6.71	6.80	7.22	8.40	9.02
Carbohydrates (By difference)	57.65	64.71	40.20	42.68	44.40	47.69
Total	100.00	100.00	100.00	100.01	100.00	99.99

[a] Leach A. E. Food Inspection and Analysis (1936) 320.
[b] Data furnished by Mr. Aurelio O. Cruz, Oil chemist, Institute of Science and Technology.

Preparation of the mold media.—In preparing the mold media, 20 grams of each material was weighed and placed separately in 500 cc Erlenmeyer flasks. To each flask 20 cc of water was added and stirred thoroughly to moisten the materials uniformly. The flasks were plugged with cotton and autoclaved for one-half hour at 15 pounds pressure. The sterilized media were sufficiently moist to allow even distribution of the inoculants and uniform growth of the molds.

[2] A mixture of the outer layer of kernels, germs, and finely-ground hulls and finely broken grains which are removed when rice is milled.

[3] The powdered cake of compact residue left after the oil from copra (dried coconut meat) has been extracted by pressing.

Selection of the most efficient protease-forming mold.—Several procedures for determining the proteolytic activity of enzymes are known. Those of Lennox(2) and Vleck and Mansfeld(7) are based on gelatin viscosity reduction; that of Landis(1) is based on the use of gelatin as a digestive substrate in measuring potency of enzymes. The procedure of Oshima and Church(3) was adopted, however, because the isolate in this investigation appeared to fall under the same group of yellow-green molds as the strains of *A. flavus-oryzæ* group. This procedure provided us with a convenient means of comparing the proteolytic values (PV) of their molds with ours.

Following the said procedure the spores of each isolate were inoculated into the rice bran and copra meal media. After 5 days of incubation at room temperature, each culture was macerated separately with 180 cc of water for 3 hours to extract the enzymes. The maceration mixture was first passed through muslin filter which was squeezed between the fingers to remove as much of the extract as possible. The aqueous extract was made clear by passing it repeatedly through filter paper. Ten cc of the filtrate computed to contain the proteolytic enzyme from 1 gram of the mold culture was diluted with water to make 100 cc. Portions of this enzyme solution such as 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0 cc, etc. were allowed to digest 5 cc of a 0.5 per cent casein solution in separate test tubes. The digestion was carried on for 1 hour at 40° C. The appearance of cloudiness or precipitation after adding 0.5 cc of a mixture of saturated magnesium sulfate solution and concentrated nitric acid to the digestion tubes indicated incomplete digestion, the density of cloudiness or precipitation being dependent upon the amount of undigested casein. The clear tube next to the one showing opacity was taken as the tube containing the minimum amount of enzyme which digested completely the casein in the 5 cc of a 0.5 per cent solution.

To express the proteolytic power, the following formula devised by Oshima and Church was adopted: If 0.025 g. or cc of the original enzymic substance digest completely 5 cc of 0.5 per cent casein solution (0.025 g. casein) in 1 hour at 40°C, then the proteolytic value (PV) of this substance is 100.

As previously described in our PV analytical procedure, the different amounts of enzyme solution which were allowed to digest 5 cc of 0.5 per cent casein solution were measured from a 100-cc test solution containing the enzyme extract from 1 gram of mold culture. The value of our original enzymic substance expressed in terms of Oshima and Church's unit was obtained by computing for the equivalent weight of mold culture containing the enzyme in the test volume of extract which completely digested 5 cc of 0.5 per cent casein solution. By applying the unit of the above authors we were able to compute for our proteolytic values. As a result of a series of similar determinations, an isolate, described below, which elaborates protease of remarkable potency was singled out. The rest of the isolates, weak producers of proteases, were discarded.

DESCRIPTION OF THE SELECTED MOLD

CULTURAL CHARACTERISTICS

Plate culture.—At room temperature, the colony on Czapek's agar grows rapidly producing, at first, a mycelial felt which is visible in 24 hours after planting the spores at the center of the culture plate. As the advancing hyphæ creep fast in all directions upon the surface of the agar, the colony gradually turns yellow starting from the middle. A microscopic examination of the aerial yellow growth shows that it is composed of developing fructiferous structures of the mold. As they mature, they change to Russet Green (20 K1)[4] and the surface of the colony becomes radiately wrinkled (Plate 1, fig. 1). The wrinkles become more prominent when the mycelial growth approaches the margin of the 90-millimeter plate. By aging the culture further, the green hue is observed to pass over to CITRINE Rhubarb (14 L6) and then finally to Calabash Medal Bronze + (14 J7). A diffusion of a certain substance produced by the mold causes the agar to change its color to Samovar (12 K7) passing over to Bronze Beeswax + (14 L9).

Agar slant.—On Czapek's agar slant the growth is at first white, gradually becoming yellow during sporulation. As the culture ages, the yellow fructifying area turns Russet Green (20 K1) and the surface of the growth becomes irregularly

[4] Color nomenclature used in this paper is from Maerz, A., and M. Rea Paul, A Dictionary of Color. McGraw-Hill Book Co., Inc. (1930) VII + 207. Citations of color according to Ridgway's "Color Standard and Nomenclature" were not made in view of the unavailability of this book at the time this investigation was conducted.

wrinkled (Plate 1, fig. 2). The wrinkles are made conspicuous by the thicker growth of conidial heads at the grooves than on the raised areas. In older cultures the yellow fructiferous growth passes over from Russet Green (20 K1) to OLD MOSS Olive Y (14 L2). The agar below the growth is colored Samovar (12 K7). Allowing the mold to remain in culture for three weeks, the OLD MOSS Olive Y (14 L2) color of the growth changes to Whippet (15 L10) and the agar below passes over from Samovar (12 K7) to Harvest (12 H9) and then to RAW SIENNAP + (13 L10).

MORPHOLOGICAL CHARACTERISTICS

Conidial heads.—The conidial heads are produced abundantly, giving color to the colony. They are generally subglobose or nearly globose, radiate (Plate 1, fig. 3) and vary from 30 to 50 or more microns in horizontal diameter.

Conidiophores.—The conidiophores arise from the superficial or submerged hyphæ, commonly 350 to 750 microns long by 5.0 to 8.0 microns in diameter, rarely more than 1,000 microns long, with colorless walls which gradually broaden upward and terminate into subglobose vesicles 10.0 to 20.0 microns in diameter. When fully developed, the upper outer surface of their walls are roughened with tiny warts, which, in dry mounts, are distinctly visible under the microscope. These structures disappear when the conidia ripen or when the culture ages. Thin-walled septa are present in many of the conidiophores in different cultures examined.

Sterigmata.—The sterigmata are arranged in single series. They vary from 6.4 to 9.6 microns in length by 3.2 to 4.8 microns in diameter. They are greenish and closely packed over one-half to two-thirds of the vesicular surface.

Conidia.—The conidia are formed in chains (Plate 2, fig. 1), greenish, mostly globose, commonly 4.0 to 4.8 microns in diameter, with walls roughened with spinules or warts (Plate 2, fig. 2).

Perithecia.—No perithecia were formed on Czapek's agar, in Moyer's sporulation media cited by Thom and Raper(6) and on steamed plant parts such as the turnip-shaped root of sinkamas [*Pachyrrhizus erosus* (L.) Urb.], cucumber (*Cucumis sativus* Linn.) fruit, okra [*Abelmoschus esculentus* (Linn.) Moench.] capsule, eggplant (*Solanum melongena* Linn.) fruit, kangkong (*Ipomoea aquatica* Forsk.) stem, cabbage (*Brassica oleracea* Linn. var. *capitata* Linn.) petiole, corn (*Zea mays* Linn.) stem, pechay (*Brassica chinensis* Linn.)

petiole, and string bean (*Phaseolus vulgaris* Linn.) pods.

Sclerotia.—No sclerotia were produced on all the media and substrates tried above in inducing the mold under study to produce perithecia.

IDENTITY

Based on the foregoing description of its cultural and morphological characteristics, our isolate should be placed under the *Aspergillus flavus-oryzæ* group, one of the naturally-related groups of Aspergilli described by Thom and Raper.(6) Its placement under the said group is based principally on its production of colorless conidiophores with wart-roughened walls and development of conidial heads with yellow-green shades. Compared also, with other species of the group, in length and diameter of conidiophores, in size and form of vesicles, in conidial heads, in conidia and in manner of coloring the agar, the organism appears to be closer to *A. flavus* Link. than to *A. oryzæ* which produces coarser growth, much longer and larger conidiophores and larger conidial heads, vesicles and conidia. But it cannot be considered as identical with *A. flavus*, because an authentic culture of the latter,[5] which is now in the stock collection of the Institute of Science and Technology, Manila, produces a colony with deeper green color. Owing to the slightly floccose habit of its growth, and to the smallness of its conidial heads and conidia, we were inclined to consider it to be a strain of *A. effusus* fittingly described as heavy-sporing. Since its conidiophores are longer than the latter and its conidial heads are not columnar, this viewpoint, however, was held as unjustified.

To check its identity and place it in its rightful specific position, a culture of the mold was sent for examination in the American Type Culture Collection in Washington, D. C. Dr. Weiss, the curator of the collection, referred the culture (ATCC No. 11866) to the Fermentation Section, Northern Utilization Research Branch, Agricultural Research Service, U. S. Department of Agriculture, in Peoria, Illinois. In response to our request, we received the following reply dated August 30, 1954, and signed by Dr. Dorothy I. Fennel, microbiologist:

> Your culture (sent to us as ATCC 11866) has been diagnosed here as typical strain of *Aspergillus oryzæ*.

[5] Brought to the Philippines by Mr. Martin S. Celino, formerly Soil Microbiologist, Bureau of Soil Conservation, Manila, from a mycological laboratory in the United States.

This was followed by another reply dated October 18, 1954, and signed by Dr. C. W. Hesseltine, incharge, Culture Collection Unit in which he says:

> We have examined the culture which was sent to us by Dr. Weiss of ATCC as his No. 11866. This culture proved to be *Aspergillus oryzæ*, a species well known for its enzyme-forming ability. It has been lyophilized in our collection as A–5777.

On the basis of the above identification and our description of the mold, we assumed that *A. oryzæ* consists of strains which are widely discrepant in certain morphological characteristics such as size of conidial heads, vesicles and conidia, and length of conidiophores. Comparing our description of the Philippine mold with that of *A. oryzæ* given by Thom and Raper,(6) we noted that the former has on the average smaller conidial heads, vesicles and conidia, and shorter conidiophores than the latter. While our description does not conform closely with that of *A. oryzæ* given in the authors' Manual, the local mold in question may have certain more important characteristics which served Drs. Fennell and Hesseltine, mentioned above, as bases for placing it under *A. oryzæ*. Henceforth, the Philippine protease-forming mold will be called *Aspergillus oryzæ* (Ahlb.) Cohn.

INFLUENCE OF TEMPERATURE ON PROTEASE PRODUCTION BY THE SELECTED STRAIN OF A. ORYZÆ

To determine the optimum temperature for protease-formation by our selected strain of *A. oryzæ* in rice bran and copra meal media, two sets of flasks containing both media were inoculated with spores and incubated at different temperatures. After 5 days of mold growth the PV's of the enzymes produced were determined. As shown in Table 2, when *A. oryzæ* is cultured in rice bran medium the maximum amount of

TABLE 2.—*Proteolytic values of enzymes produced from 5-day-old cultures of the Philippine strain of A. oryzæ in rice bran and copra meal at different temperatures.*

Incubation temperature	Rice bran	Copra meal
°C	*PV* [a]	*PV* [a]
15	60	----
22	313	208
24	313	230
25	313	250
27	313	365
30 (Room temp.)	250	139
37	156	83

[a] Average proteolytic value.

enzyme, PV 313, is produced at incubation temperatures of 22, 24, 25, and 27°C. In copra meal medium the maximum amount of enzyme, PV 365, is produced when the mold culture is incubated at 27°C, the apparent optimum temperature for protease formation in this medium. The temperature optimum for protease formation by *A. oryzæ* is of a wider range in rice bran than in copra meal. However, more protease is produced in copra meal medium than in rice bran.

RELATION OF INCUBATION PERIOD TO PROTEASE FORMATION

Two sets of flasks containing rice bran and copra meal media respectively were inoculated with the Philippine strain of *A. oryzæ* and incubated at 27°C, the optimum temperature for protease formation by the mold under study in both media. The proteolytic values of the enzymes produced daily by the mold are shown in Table 3.

TABLE 3.—*Period of incubation in relation to protease formation by the Philippine strain of A. oryzæ in rice bran and copra meal media at 27° C.*

Period of incubation	Rice bran	Copra meal
Days	*PV* [a]	*PV* [a]
1	69	42
2	167	357
3	250	625
4	313	500
5	313	357
6	294	208
7	277	208

[a] Average proteolytic value.

Table 3 shows that when *A. oryzæ* is grown in rice bran medium, the amount of protease produced after a day's growth is only PV 69. After 2 days, PV increased to more than 2 times. The increase continues until after 4 to 5 days, when it reaches PV 313, the maximum amount so far recorded. As the culture becomes older, the amount of available protease decreases.

When the same mold is cultured in copra meal, the protease produced after 1 day gives PV 42, but is increased to 8.5 times after 2 days, reaching its maximum potency to almost 15 times at the end of 3 days and gradually diminishing, as the culture becomes older, to only 5 times after 7 days.

Table 3 also shows that the maximum amount of protease produced by *A. oryzæ* in copra meal is not only 2 times that

in rice bran but that it is also produced 1 or 2 days earlier than in the latter medium. It is possible that the high protein content (27.60 per cent) of copra meal is the stimulating factor in the production of more protease in this medium. Oshima and Church mention that generally, substrates containing substances closely related in chemical structure to the desired enzyme appear to exhibit a better stimulating effect for enzyme formation than substances not closely related; that for the production of protease, proteins are strong stimulants, followed in decreasing strength by peptides, amides, ammonia and other inorganic nitrogenous substances.

COMPARATIVE PV OF PROTEASES PRODUCED BY DIFFERENT STRAINS OF A. FLAVUS-ORYZÆ GROUP

For purposes of comparison, the PV's of the enzymes produced by the different strains of molds belonging to the *A. flavus-oryzæ* group studied by Oshima and Church and the Philippine strain of *A. oryzæ* isolated by us are given in Table 4.

TABLE 4.—*Comparative proteolytic values of proteases produced by Oshima and Church's strains of A. flavus-oryzæ and Philippine strain of A. oryzæ.*

Investigators	Culture No.	Strain of mold	Proteases Oshima's value
Oshima and Church	113	*Aspergillus oryzae* (Ahlb.) Cohn.[b]	8[a]
	AOAc	Form intermediate between *A. flavus* and *oryzæ* [b]	8[a]
	AOP	do	35
	AOb	do	42
	AOAb	do	42
	AO5a	do	42
	AO2b	Resembling strain F of Takahashi[b]	42
	108	*Aspergillus flavus* Link.[b]	56
	4272.2	do	56
	AO4b	Form intermediate between *A. flavus* and *oryzæ* [b]	56
	AO3a	do	56
	AO2a	do	56
	AO4a	do	83
	AO5c	*Aspergillus flavus*[b]	83
	A	Form intermediate between *A. flavus* and *oryzæ* [b]	83
	4328	*Aspergillus flavus* Link.[b]	100
	AO1	Form intermediate between *A. flavus* and *oryzæ* [b]	100
	3509	*Aspergillus parasiticus* Speare [b]	130
	AO old	*Aspergillus oryzae* (Ahlb.) Cohn.[b]	166
	AO3b	*Aspergillus parasiticus* type [b]	168
	APa	Form intermediate between *A. flavus* and *oryzæ*	178
	AOK	do	200
	AO5b	*Aspergillus oryzæ* [b]	208
	APb	*Aspergillus effusus* type[b]	260
Baens-Arcega, Marañon, and Palo	OM	*Aspergillus oryzæ* (Philippine strain) [c]	318
	OM	do [d]	625

[a] Before sporing.
[b] Wheat bran medium was used.
[c] Rice bran medium was used.
[d] Copra meal medium was used.

The figures show that the protease produced in copra meal by the Philippine strain of *A. oryzæ* is 3 times as potent as that of the most efficient strain of *A. oryzæ* and more than 2 times that of an *Aspergillus effusus* type studied by Oshima and Church. Although the protease produced by the Philippine mold is less in rice bran, still it is more potent than that produced by any of the above-mentioned foreign species cultivated in wheat bran.

SUMMARY

Several protease-forming yellow-green molds were isolated.

The suitable culture media for protease production by these isolates are copra meal and rice bran, cheap local farm by-products, which contain 27.60 per cent and 17.94 per cent of protein respectively.

By repeatedly culturing the isolates in copra meal and rice bran media, only one was found to produce protease of excellent digestive potency as evaluated with the Oshima and Church method.

The selected isolate, whose cultural and morphological characteristics are described by us, was identified as a typical strain of *Aspergillus oryzæ* by Drs. Dorothy I. Fennell and C. W. Hesseltine of the Agricultural Research Service, U. S. Department of Agriculture, Peoria, Illinois.

Optimum temperatures for protease production is 27°C in copra meal and 22 to 27° C in rice bran.

Duration of incubation for maximum protease formation is 3 days in copra meal and 4 to 5 days in rice bran. The digestive ability of the protease produced in copra meal is 2 times that produced in rice bran. This may be due to the stimulating effect on the mold of the high protein content of copra meal.

The potency of the protease produced by the Philippine strain of *A. oryzæ* in copra meal is 3 times that of the most efficient *A. oryzæ* and 2 times that of the *Aspergillus effusus* type cultured in wheat bran by Oshima and Church.

ACKNOWLEDGMENT

The authors are grateful to Miss Angelina Ll. Arguelles and Mrs. Vicenta V. Valencia for technical assistance rendered them in the course of this study.

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ILLUSTRATIONS

A Philippine strain of *Aspergillus oryzæ*.

PLATE 1

FIG. 1. A 6-day-old plate culture on Czapek's agar; approximately, × 0.8. Note the radial wrinkling on the surface of the fungus growth.

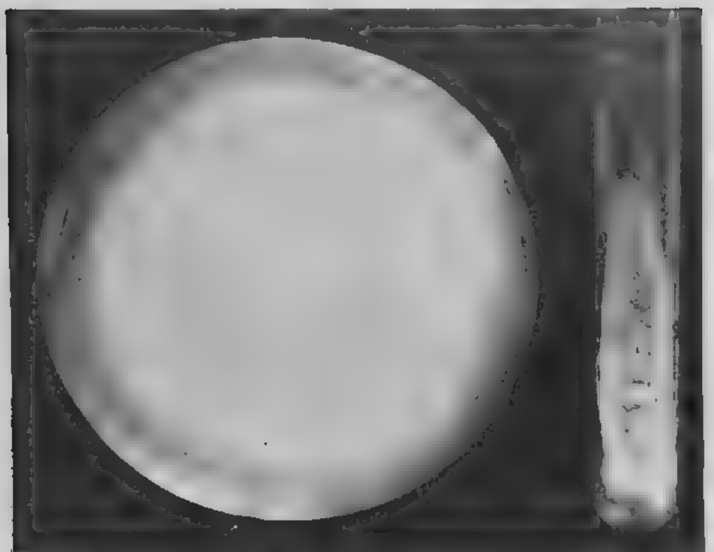
2. The same mold on Czapek's agar slant; approximately, × 0.8. Note also the surface wrinkling of the growth.

3. Fructiferous structure from a 3-day-old plate culture on Czapek's agar; approximately, × 782.

PLATE 2

FIG. 1. Sporehead from a 3-day-old culture on Czapek's agar approximately, × 1200.

2. Conidia from a 2-day-old culture on the same medium as seen under the oil-immersion lens; approximately, × 1200.



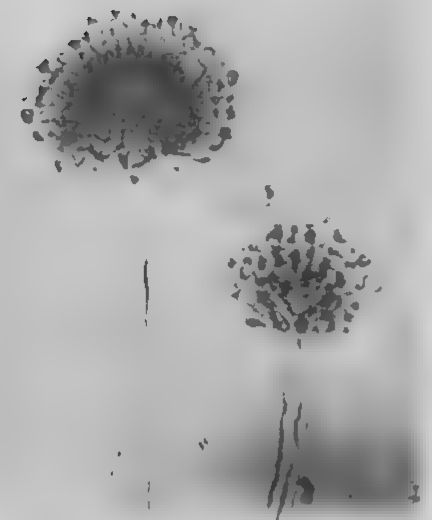


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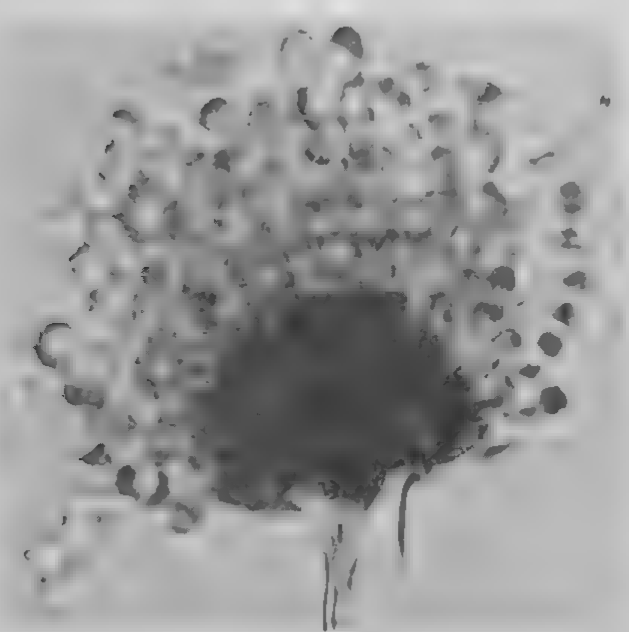
PLATE 1.



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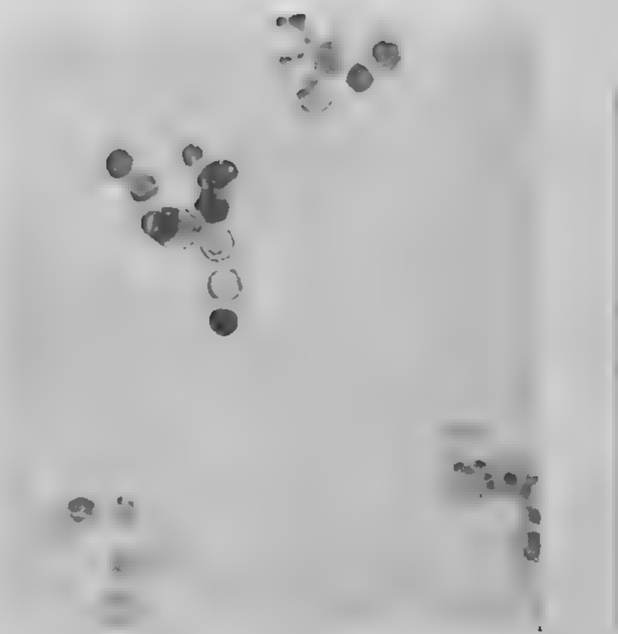

2

PLATE 2.

COMPOSITION OF PHILIPPINE FOODS, V

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This paper is a continuation of the series of reports on the analysis of local foods and food materials and deals with local species of fish and other sea foods. Fish occupy an important place in local diet since they contribute most of the protein needs of a large majority of Filipinos. According to Herre (1927) approximately one-tenth of all known kinds of fish, or about 2,000 species are present in Philippine waters and most of them are edible. This report presents analytical data for 166 samples from 105 species of local marine life, some of which were in both fresh and processed states. These are some of the edible species commonly used by Filipinos. Represented are 95 samples of fresh fish, 21 processed fish, 13 crustaceans, 14 mollusks, 9 processed crustaceans and mollusks, and 14 samples of miscellaneous species.

Previous studies on the proximate chemical composition of some Philippine fish and other marine life were made by Balagtas (1928), Etorma (1928), Valenzuela (1928), and Sulit (1953). The last study includes values for calcium, phosphorous and potassium. Santos and Ascalon (1931) and Hermano (1932) have also reported the proximate chemical composition of some species of Philippine fish. Other workers like Galvez and Santos (1932) confined their studies to special research on the amino acid content of *kandule;* Birosel and Sison (1932) on the vitamin A in the body and liver oils of some Philippine fish and Manon (1937) on the amino acid content of *kandule* at different ages.

Most of these samples used in this study were collected during 1953 and 1954, a great number of which were obtained with the help of the Philippine Bureau of Fisheries, the others having been purchased from the markets in and around Manila.

Sampling and analyses were made on about a kilo of each sample according to methods reported in the first paper of

this series (Intengan, et al. 1953). Each sample was mechanically made homogeneous but without being stabilized, and then kept frozen until needed for analysis. Vitamin analyses were made within one week after sampling. Moisture, nitrogen, fat, calcium, phosphorous, iron, thiamine, riboflavin, and niacin as well as the percentage of edible portion were determined. All analyses, unless indicated otherwise, were done on the raw sample. The results presented are values per 100 grams of the edible portion.

No attempts are made to describe any of the samples included in this study. However, the scale drawings presented in the Research Report 26 (1950) entitled "Fish Processing Handbook for the Philippines" and in Circular 14 (1948) entitled "English and Local Common Names of Philippine Fishes," both published by the Fish and Wildlife Service of the United States Department of the Interior may be found useful in identifying most of the common species of Philippine fish reported in the present paper.

RESULTS AND DISCUSSION

Results of the analyses of 166 samples consisting of fish, crustaceans, mollusks, and other miscellaneous species and their by-products are given in the accompanying table. On some food items, analyses are reported for two or more samples and it is of interest to note the variations in their composition. Dill (1921) stated that in general the variations in composition of fishes are erratic and hard to explain. On the other hand Herre (1927) and others attribute these differences to such factors as changes in food condition and food supply, localities where fish are caught, seasons of the year as well as time of spawning. Concerning the last factor, fishes are found to have maximum fat deposit just before spawning and to have the minimum fat deposit a few weeks afterwards.

Clark and Almy (1918) who have made a series of studies on seasonal variations in composition attribute variations of fat content with seasons of the year which are considerably increased in the summer and autumn. However, the variations are caused not by season but by the approaching maturity of the fish.

In general, the edible portion of fish is from 30 to 60 per cent; of shrimps, 60 per cent; of crabs, 40 per cent; and of mollusks, from 20 to 25 per cent.

The nitrogen content of fish and crustaceans show relatively similar values averaging about 20 gm per cent protein. This is comparable to the protein content of meat cuts. Mollusks; however, have lower values giving an average of about one-half the protein content of fish and crustaceans.

Values obtained for ether extract agree generally with those reported by other workers. Compared to flesh meat, sea foods are lower in fat content. Very few species have a fat content above 5 per cent: namely, *bañgus, malapito, maya-maya, talakitok, tamban,* and *tilapia.*

Among the samples studied, mollusks give highest ash values, followed by crustaceans and lastly by fish. A high ash content is usually accompanied by high mineral values especially in iron and calcium. Since sampling is made on the edible portion, exceptional values in mineral calcium are found in dried *dilis* and *alamang* because these items are eaten with the bones and skin.

Carotene was determined only on some samples of mollusks and crustaceans. Crab fat was found to have high carotene values ranging from excellent (*alimañgo*, 14,150 I. U. Vitamin A) to fair values (*alimasag,* 728 I. U. vitamin A). Among the mollusks analyzed, bean clams (*halamis*) were highest in carotene giving a vitamin A equivalence of 655 I. U.

Sea foods are generally poor in thiamine content with a few exceptions. Two species of sea catfish were found excellent sources for this vitamin giving values varying from 0.60 to 0.69. Malapito (*pampano*) and *samaral* which contain 0.21 to 0.42 mg thiamine may be considered good sources. Except for the crab fat and the *talaba* which contain appreciable amounts of thiamine, the samples of crustaceans and mollusks reported in this paper were found to contain poor amounts of this vitamin.

Among fair sources of riboflavin are: *banak,* 0.297 mg; *bangolngok,* 0.240 mg; *kandule,* 0.291 mg; *talilong,* 0.297 mg; and *talimosak,* 0.270 mg. Only *martiniko* has a slightly higher value, 0.38 mg. About 14 other species contain between 0.1 to 0.2 mg of riboflavin.

In general, sea foods and fish may be considered good sources of niacin. Among the good sources are: *tulingan,* 15.64; *alumahan,* 11.27; *galongong,* 10.97; *oriles,* 10.81; *tsabita,* 10.73; *albakora,* 9.80; *tamban,* 7.94; *dapa,* 7.49; *maya-maya,* 7.53; *salmon,* 7.16; and *bakoko,* 7.12.

TABLE 1.—*Fish, fresh.*

Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion											
				Moisture	Nitrogen	Fat	Ash	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
			Per cent	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
Alokaak	*Pseudosciaena anea*	Plain croaker	46.8	79.7	2.915	0.60	.97	34.86	117.06	0.46	------	0.010	0.084	2.15	------
Do	do	do	42.1	78.0	3.199	0.22	1.08	35.05	133.87	0.32	------	0.045	0.033	2.50	------
Albakora	*Neothunnus macropterus.*	Yellow fin tuna	76.6	75.8	3.630	0.18	1.34	16.36	191.39	1.24	------	0.434	0.047	9.80	------
Alumahan	*Rastrelliger chrysozonus.*	Striped mackerel	44.9	76.7	2.750	4.07	1.08	38.58	195.81	1.43	------	0.056	0.066	11.27	------
Apahap	*Lates calcarifer*	Sea bass	56.6	79.9	2.670	0.66	1.12	46.03	154.78	0.55	------	0.050	0.058	3.22	------
Do	do	do	53.1	75.9	3.034	0.15	1.11	46.65	146.13	tr.	------	0.047	0.059	2.97	------
Asohos	*Sillago sihama*	Whiting	46.1	74.8	3.397	0.49	1.58	67.35	177.22	0.89	------	0.021	0.060	6.85	------
Babansi	*Therapon theraps*	Three-lined theraponid.	40.3	75.2	3.546	0.58	1.41	59.17	213.43	0.91	------	0.028	0.081	6.22	------
Bakokong moro	*Sparus berda*	Porgy, fresh-water.	-----	76.1	3.272	0.17	1.31	15.33	191.68	0.39	------	0 015	0.034	7.12	------
Bagaong	*Therapon jarbua*	Convex-lined theraponid.	42.0	77.6	3.040	0.25	1.31	40.01	193.32	0.55	------	0.021	0.063	6.13	------
Balila	*Trichiurus haumela*	Hairtail	61.4	81.5	2.652	0.30	0.88	75.78	76.13	0.61	------	0.016	0.076	3.20	------
Banak, Alilong	*Mugil vaigiensis*	Mullet, young	45.0	74.5	3.163	3.24	1.26	95.10	187.20	0.39	------	0.041	0.297	4.78	------
Do	do	do	52.0	71.9	3.499	1.99	1.24	23.71	201.74	0.61	------	0.005	0.074	6.72	------
Bañgus	*Chanos chanos*	Milkfish	68.4	72.1	3.285	6.16	1.14	51.17	162.44	0.32	------	0.013	0.054	6.44	------
Bangoknok	------	------	29.2	77.8	3.066	0.74	1.25	267.78	130.06	2.25	------	0.018	0.240	3.12	------
Biang pute	*Glossogobius giurus*	Flat-headed goby.	30.0	76.4	3.229	0.27	1.23	64.77	135.03	0.63	------	0.013	0.046	1.56	------
Bia	do	do	44.8	76.6	3.290	0.06	1.19	103.87	167.46	tr.	------	0.022	0.041	4.79	------
Bidbid	*Elops hawaiiensis*	Ten pounder	53.0	78.4	3.126	0.30	1.28	65.37	225.42	0.35	------	0.050	0.039	2.10	------
Bisugo	*Nemipterus taeniopterus.*	Ribbon-finned nemipterid.	39.5	76.4	3.083	0.92	1.26	38.79	203.95	0.29	------	0.033	0.019	2.74	------
Do	*Nemipterus japonicus*	Long-tailed nemipterid.	43.8	79.4	2.925	0.32	1.25	135.47	172.59	0.55	------	0.010	0.030	1.40	------
Bitilla	*Lethrinus opercularis.*	Common porgy	45.4	75.2	3.330	0.19	1.23	48.38	202.78	0.43	------	0.010	0.024	7.36	------
Bongoan	*Arius leiotetocephalus.*	Sea catfish	43.4	77.2	3.310	0.55	1.13	37.41	170.43	2.36	------	0.692	0.120	4.08	------
Buan-buan	*Megalops cyprinoides.*	Tarpon	44.5	75.6	3.546	0.20	1.11	54.44	262.69	0.66	------	0.016	0.060	5.11	------

Buguing	*Hemiramphus georgii.*	Nos-spotted halfbeak.	49.2	80.3	2.769	1.41	0.60	229.20	227.37	1.45	------	0.004	0.042	3.05	------
Bulador	*Cypselurus oligolepis.*	Small-scaled flying fish.	61.7	75.3	3.364	0.20	1.29	44.81	213.04	0.51	------	0.026	0.063	5.65	------
Kabang	*Sciaena dussumieri*	Smooth-scaled whiskered croaker	35.9	75.5	3.021	2.00	1.40	109.24	171.07	0.89	------	0.030	0.047	3.40	------
Kabasi	*Anodontostoma chacunda.*	Bastard shad, Basing.	26.6	77.8	2.887	1.19	1.28	124.97	191.55	0.46	------	0.010	0.043	2.48	------
Kalaso	*Saurida tumbil*	Common lizard fish.	33.6	78.4	3.012	0.09	1.35	48.73	201.43	0.44	------	0.104	0.028	3.42	------
Kambabalo	*Tylosurus giganteus*	Common garfish	63.8	70.4	4.248	0.87	1.70	98.34	260.54	0.98	------	0.004	0.037	0.86	------
Kanduli	*Arius manillensis*	Manila Sea catfish.	19.1	77.6	2.762	0.59	1.30	51.51	179.59	1.62	------	0.661	0.291	5.41	------
Do	do	do	53.3	76.4	3.059	2.33	1.19	21.71	194.45	0.63	------	0.600	0.103	3.68	------
Karang	------	Amberfish	57.6	77.5	3.212	0.97	1.09	34.69	102.25	0.67	------	0.027	0.098	7.23	------
Kitang	*Scatophagus argus*	Spade fish	46.4	76.0	3.314	1.94	1.40	74.23	211.47	0.73	------	0.021	0.151	5.26	------
Kogeta	------	------	93.2	84.7	2.030	0.60	1.34	29.08	111.31	1.54	------	0.010	0.052	2.14	------
Dalag	*Ophicephalus striatus.*	Mudfish, murrel	45.0	------	2.776	0.07	1.31	72.23	167.03	0.56	------	0.005	0.030	4.24	------
Dalagang bukid	*Caesio chrysozonus*	Golden caesio	50.2	78.9	3.118	0.68	1.37	34.59	191.82	0.69	------	0.023	0.027	4.32	------
Do	*Caesio cuning*	Denticulated caesio.	48.3	77.5	------	0.75	1.26	34.09	164.74	0.51	------	0.010	0.018	2.17	------
Dalangat	*Leiognathus daura*	Black-finned slipmouth.	35.5	79.2	3.190	1.01	1.19	52.24	159.02	0.70	------	0.017	0.037	1.94	------
Damis	*Hynnis momsa*	Philippine jack	53.6	74.4	3.450	0.43	1.49	21.50	226.32	0.73	------	0.064	0.025	7.06	------
Dapang talog	*Pseudorhombus dipodon.*	Rough-scaled brill.	63.5	76.1	3.278	0.22	1.34	28.32	205.28	0.61	------	0.032	0.037	5.47	------
Do	do	do	45.7	75.9	3.287	0.13	1.31	30.95	202.19	0.41	------	0.056	0.042	7.49	------
Dilis, dulong	*Stolephorus commersonii.*	Long-jawed anchovy.	100.0	76.8	2.370	1.98	3.88	785.61	452.19	0.83	------	0.005	0.096	3.77	------
Dilis, dulong large.	do	do	74.7	76.1	3.347	0.25	1.92	153.32	303.74	0.63	------	0.009	0.068	3.58	------
Dilis, no heads	do	do	84.5	72.0	3.188	------	2.90	500.59	291.12	0.96	------	0.005	0.074	2.72	------
Galongong	*Decapterus macrosoma.*	Scar	40.1	76.6	3.075	1.65	1.14	70.98	214.35	0.69	------	0.169	0.194	10.97	------
Hasa-hasa	*Pastrelliger brachysomus.*	Short-bodied mackerel	52.0	76.0	3.334	0.65	1.54	74.20	203.68	0.89	------	0.058	0.120	6.58	------
Hito	*Clarias batrachus*	Catfish, fresh water.	84.5	77.0	3.147	0.42	1.14	50.59	167.54	tr.	------	0.008	0.031	3.20	------
Hubad	------	------	55.6	------	3.074	0.17	0.89	83.94	119.95	1.52	------	0.004	0.029	2.46	------
Isdang loro	*Scarus microchipunctatus.*	Parrot fish	35.0	80.2	3.083	0.35	1.08	35.64	143.57	0.47	------	0.005	0.052	1.36	------
Labahita	*Acanthurus bleekeri*	Surgeon fish	------	79.4	2.850	0.63	1.30	45.06	168.82	0.49	------	0.027	0.026	3.82	------
Longaray, laot	------	------	45.0	79.3	2.792	0.42	1.15	66.53	149.51	0.54	------	0.011	0.039	1.53	------
Lapad, Halobaybay.	*Sardinella perforata*	Deep-bodied herring	46.6	77.3	2.924	0.33	1.70	156.79	290.24	1.54	------	0.001	0.033	2.41	------

TABLE 1.—*Fish, fresh.*—Continued

Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion											
				Moisture	Nitrogen	Fat	Ash	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
			Per cent	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
Lapulapu	*Epinephelus corallicola.*	Spotted grouper.	45.7	79.1	3.059	0.77	1.20	71.10	171.06	0.83	------	0.043	0.042	1.93	------
Do	do	do	52.5	79.7	3.001	0.07	1.08	39.37	175.12	0.33	------	0.032	0.028	6.72	------
Malabanos	*Muraenidae*	Moray	100.0	72.0	3.219	3.95	1.21	63.03	82.73	0.48	------	0.010	0.030	3.09	------
Malaking mata	*Monotaxis grandoculis.*	Porgy, big-eyed	50.5	------	2.722	------	1.40	61.88	235.28	1.65	------	0.029	0.178	3.17	------
Do	do	do	54.0	77.0	3.376	0.56	1.19	38.81	119.67	0.62	------	0.056	0.047	6.04	------
Maripinto, muslo manipis.	*Caranx* sp.	Pompano	38.4	77.5	2.919	0.50	1.22	44.39	169.86	0.51	------	0.111	0.072	5.62	------
Do	do	do	56.7	73.2	3.080	3.07	1.19	36.14	187.86	0.62	------	0.423	0.150	5.79	------
Malakapas	*Gerres filamentosus*	Spotted majarras	44.3	78.4	3.135	------	1.20	66.24	191.19	0.44	------	0.031	0.085	5.31	------
Mamale	*Polynemidae*	Threadfin	40.1	77.1	3.342	1.06	1.29	65.99	161.98	tr.	------	0.022	0.052	1.83	------
Mamaleng bato	*Polynemus microstoma.*	Small-mouthed threadfin.	42.2	75.4	3.152	0.20	1.09	34.85	183.43	0.59	------	0.019	0.110	4.57	------
Martiniko, liwalo	*Anabas testudineus*	Climbing porch	49.2	------	------	------	1.19	130.66	138.69	0.63	------	0.019	0.361	3.67	------
Matang baka	*Caranx crumenophthalmus.*	Scad, big-eyed	50.4	79.8	2.807	0.13	1.84	50.13	114.63	0.38	------	0.026	0.077	3.20	------
Maya-maya	*Lutjanus malabaricus.*	Malabar red snapper.	55.6	69.5	2.991	9.23	0.85	41.35	153.90	0.81	------	0.098	0.152	7.53	------
Do	do	do	47.1	76.6	------	0.13	1.08	37.41	126.03	0.38	------	0.045	0.109	2.89	------
Mayang	*Drepane punctata*	Drepane	------	------	------	------	------	30.27	148.87	0.40	------	0.027	0.031	3.66	------
Orines	*Megalaspis cordyla*	Hardtail	29.9	75.7	3.201	1.80	1.09	45.07	139.51	0.58	------	0.070	0.126	10.81	------
Parang-parang	*Chirocentrus dorab*	Silver-bar fish	76.4	75.3	3.368	0.17	1.60	97.31	277.63	1.09	------	0.035	0.053	6.59	------
Paro-paro	*Chaetontidae*	Butterfly fish	48.8	78.4	3.164	0.59	1.08	56.87	153.19	1.03	------	0.035	0.069	4.39	------
Salay-salay aso	*Caranx Kalla*	Crevalle	65.5	76.5	3.086	1.03	1.46	92.82	220.69	1.25	------	0.018	0.121	4.22	------
Salay-salay lalaki	*Caranx djedaba*	do	------	77.6	2.664	0.35	------	------	0.00	------	------	0.012	0.033	3.58	------

Salmon	*Elagatis bipinnulatus*	Two-pinned runner.	26.6	76.9	3.105	0.60	1.22	31.69	138.28	1.74	------	0.084	0.084	7.16	------
Do	do	do	62.2	76.1	3.158	0.84	1.22	29.36	187.56	3.04	------	0.025	0.032	4.78	------
Samaral	*Teuthis javus*	Javan siganid	39.0	73.9	3.033	2.47	1.21	37.02	102.22	0.38	------	0.279	0.107	5.66	------
Do	do	do	45.2	77.1	3.136	0.23	1.09	44.73	168.11	0.44	------	0.212	0.139	5.56	------
Do	do	do	48.3	79.0	3.063	0.56	1.24	40.50	93.77	0.66	------	------	0.134	4.04	------
Sapsap	*Leiognathus equulus*	Common ship-mouth.	30.9	77.1	2.795	1.80	1.30	49.96	147.83	tr.	------	0.013	0.040	2.04	------
Saramulyete	*Upenoides sulphureus.*	Goatfish	38.1	78.3	3.133	0.94	1.22	123.96	183.52	1.26	------	0.024	0.046	1.34	------
Do	do	do	39.0	77.8	2.859	1.72	1.11	58.05	156.34	0.55	------	0.025	0.030	1.47	------
Silinyasi, tunsoy	*Sardinella fimbriata*	Young herring	59.9	75.1	3.496	0.35	1.92	205.32	233.02	1.28	------	0.008	0.052	6.31	------
Sunog	*Platycephalus indicus.*	Indian flathead	46.4	77.7	3.295	0.34	1.17	79.09	174.37	0.59	------	0.019	0.030	5.05	------
Talakitok	*Caranx sexfasciatus*	Banded cavalla	53.5	70.0	3.193	5.93	1.00	57.16	210.17	0.70	------	0.037	0.059	6.19	------
Do	do	do	------	73.0	3.073	6.25	1.18	70.69	161.18	0.94	------	0.126	0.103	4.82	------
Talilong	*Mugil melinopterus*	Black-finned mullet.	45.0	74.5	3.163	3.24	1.26	95.08	187.19	0.39	------	0.041	0.297	4.73	------
Talimosak	*Oxyurichthys microlepis.*	------	100.0	78.1	2.651	2.74	2.63	621.29	301.90	2.49	------	0.071	0.270	1.31	------
Tamban	*Sardinella longiceps*	Indian sardine	------	76.0	2.837	4.61	1.35	95.73	219.89	1.38	------	0.010	0.067	7.94	------
Tangingi	*Cybium commersoni.*	Spanish mackerel.	48.6	82.1	2.551	0.21	1.62	23.03	236.09	1.00	------	0.023	0.088	4.22	------
Tilapia	*Scomberoides lysan.*	Leather jacket	34.2	75.8	2.478	6.38	1.16	76.54	196.00	tr.	------	0.016	0.031	3.56	------
Torsillo asogon	*Sphyraena jello*	Banded barracuda.	32.7	79.4	2.948	0.41	1.17	45.21	174.39	0.53	------	0.044	0.087	5.88	------
Do	*Sphyraena obtusata*	Striped barracuda.	56.0	77.4	2.792	1.84	0.90	57.26	142.66	0.60	------	0.012	0.039	2.54	------
Do	do	do	62.7	77.6	3.273	0.29	1.27	70.62	170.12	0.55	------	0.004	0.015	2.20	------
Tsabilita	*Mene maculata*	Moonfish	47.9	72.9	3.907	2.05	1.30	21.89	226.73	1.19	------	0.035	0.037	10.73	------
Tulingan	*Auxis thazard*	Tuna, bonito	54.9	70.2	4.134	2.21	1.28	23.10	214.59	------	------	0.043	0.144	15.64	------
Tunsoy	*Sardinella fimbriata*	Frimbriated hearing.	61.0	75.3	3.186	2.28	1.28	177.29	223.03	1.58	------	0.004	0.097	3.78	------

TABLE 2.—*Fish, processed.*

Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion											
				Moisture	Nitrogen	Fat	Ash	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
			Per cent	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
I. SALTED AND DRIED															
Alakaak, daing	*Pseudosciaena anea*	Plain croaker, dried	------	87.2	6.291	6.10	17.05	234.86	217.77	1.97	------	0.007	0.080	4.25	------
Alumahan, daing	*Rastrelliger crysozonos*	Mackerel, dried	55.7	38.5	6.862	5.18	14.20	182.69	350.69	2.83	------	0.010	0.068	14.58	------
Bakalao, daing	*Gradus* Sp.	Cod, dried	84.3	------	8.475	1.44	15.17	655.79	694.10	4.29	------	0.033	0.063	6.13	------
Bakoko, daing	*Sparus berda*	Pomadasid, dried	------	43.8	5.482	6.15	15.66	186.89	280.14	1.89	------	0.006	0.033	9.43	------
Bisugo, daing	*Nemipterus taeniopterus*	Nemipterid, dried	50.2	40.6	5.531	2.94	18.65	244.81	254.06	0.71	------	0.016	0.011	6.48	------
Kabasi, daing	*Anodontostoma chacunda*	Shad, dried	36.0	48.3	3.795	6.45	19.39	499.90	483.21	2.80	------	0.011	0.154	3.79	------
Kanduli, daing	*Arius manillensis*	Manila catfish, dried	55.7	36.7	7.218	1.17	15.65	139.81	345.63	6.37	------	0.139	0.035	2.22	------
Dilis, binilad	*Stolephorus commersonii*	Anchovy mullet	100.0	16.4	11.624	4.22	------	2355.20	1583.40	22.54	------	0.011	0.353	23.15	------
Do	do	do	100.0	17.1	8.563	------	13.25	2406.07	1395.48	24.28	------	0.007	0.103	7.45	------
Dilis, gibing	do	Anchovy, powdered	100.0	9.1	13.433	2.62	------	1937.60	1230.50	31.35	------	0.056	0.227	9.45	------
Galonggong, daing	*Decopterus macrosoma*	Big-bodied round scar scad, dried	61.8	37.6	6.932	3.87	14.76	628.84	633.79	3.59	------	0.018	0.089	12.31	------
Matang baka, daing	*Caronx crumenophthalmus.*	Big-eyed scad, dried	67.5	41.7	6.060	1.50	17.44	331.54	816.99	5.07	------	0.020	0.053	13.51	------
Talitong, daing (kapat).	*Mugil dussumieri*	Thicked-lipped mullet	35.2	43.5	5.124	5.33	16.04	312.60	195.65	2.49	------	0.001	0.099	2.53	------
Tangginggi, daing	*Cybium commerson*	Spanish mackerel, dried	59.2	40.4	6.392	2.30	14.37	86.20	328.73	1.45	------	0.018	0.022	12.00	------
Tamban, daing	*Sardinella longiceps*	Indian sardine, dried	43.2	43.1	5.984	1.08	15.98	283.22	314.70	3.65	------	0.010	0.105	14.47	------
Tawilis, daing	------	------	47.8	51.5	4.1985	6.77	------	250.85	167.99	18.80	------	0.008	0.019	2.91	------
Tunsoy, daing	*Sardinella fimbricta*	Herring, dried	59.6	42.7	6.086	2.40	13.83	199.67	365.93	2.60	------	0.006	0.245	7.09	------
II. SMOKED															
Bangus, tinapa	*Chanos chanos*	Milkfish, smoked	------	63.0	4.636	8.28	1.94	75.72	150.77	0.99	------	0.016	0.028	8.04	------
Hasa-hasa, tinapa.	*Rastrelliger bracnyosomus.*	Mackerel, smoked	55.1	61.0	4.864	1.72	5.78	51.90	239.01	1.16	------	0.010	0.085	9.75	------
Tamban, tinapa.	*Sardinella longiceps*	Sardine, smoked	61.3	55.5	5.307	3.61	5.14	203.06	175.19	0.76	------	0.009	0.093	5.02	------
III. CANNED															
Salmon	*Salmonidae*	Salmon, canned	100.0	64.0	3.637	11.36	2.71	426.79	314.97	0.57	------	0.014	0.003	7.78	------

TABLE 3.—*Crustaceans and mollusks.*

Local Name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion											
				Moisture	Nitrogen	Fat	Ash	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
			Per cent	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
I. CRUSTACEANS															
Alamang	*Alya* sp.	Shrimps	100.0	79.0	2.595	1.27	3.09	756.70	291.78	2.25	------	0.039	0.131	2.04	------
Alimasag	*Neptunus pelagicus*	Blue-crab, meat	33.8	75.5	3.177	0.51	1.91	134.14	180.46	tr	tr	0.036	0.068	3.94	------
Alimasag, aligue	do	Blue-crab, fat	100.0	76.8	1.833	4.45	2.60	282.78	201.89	0.95	0.4365	0.087	0.494	1.06	------
Alimango	*Scylla serrata*	Crab, meat	------	75.6	3,223	4.00	1.49	69.43	159.20	0.88	0.2861	0.84	0.118	2.34	------
Alimango, sipit	do	Crab meat, claws	41.6	75.1	3.130	4.00	1.79	116.25	143.07	1.07	0.4761	0.053	0.251	1.89	------
Alimango, aligue	do	Crab, fat	100.0	58.1	4.152	5.60	1.83	59.75	402.32	4.41	8.4943	0.791	0.922	1.31	------
Ilipon, suaho	*Penaeus incisipes*	Shrimp, medium	64.3	75.6	3.024	1.69	1.37	165.66	194.82	1.82	0.2536	0.006	0.055	2.37	------
Hipon, malaki		Shrimp, large	60.9	72.6	3.650	0.27	1.75	103.90	239.27	1.14	0.0136	0.006	0.039	5.12	------
Hipon, puti	*Penaeus indicus*	Shrimp, white	62.5	78.5	2.741	0.41	1.37	161.46	209.82	0.43	------	0.008	0.045	3.47	------
Sugpo	*Penaeus monodon*	Jumbo shrimps	62.1	75.6	3.321	0.67	1.34	73.93	235.44	1.28	0.0477	0.017	0.054	3.97	------
Talangka	*Potamon* sp.	Fresh water crab	45.3	68.1	2.201	3.81	6.22	4110.70	209.43	1.05	1.7507	0.050	0.789	2.88	------
Uiang	*Palinurus* sp.	Lobster	56.3	72.2	3.461	0.35	0.96	30.24	302.70	1.18	0.009	0.006	0.073	6.36	------
Do	do	do	51.6	72.6	2.763	3.12	1.25	70.79	175.83	0.72	------	0.008	0.020	2.1[illegible]	------
Abalone	*Haliotis* sp.	------	------	72.6	2.918	0.39	2.95	20.73	106.15	0.79	0.0184	0.0	0.036	1.19	------
II. MOLLUSKS															
Balay	*Lingula unguis*	Lamps shells	42.6	78.6	1.985	3.43	1 16	49.03	130.42	8.08	------	0.014	0.244	1.80	------
Balay, buntot	do	Lamp, tails	------	88.0	1.278	0.36	0.52	13.43	74.14	0.72	------	0 005	0.038	1.08	------
Halaan	*Arca* sp.	Chest shells	24.3	89.5	1.202	0.58	2.04	174.40	105.80	5.71	0.0260	0.002	0.200	1.51	------
Halamis	*Donax radians*	Bean clams	20.6	82.2	1.410	1.69	2.25	78.45	115.14	1.61	0.3929	0.003	0.120	2.33	1.87
Kabibi	*Cyrena ventricosa*	Green clams	22.4	82.8	1.650	1.57	0.82	117.72	105.10	4.00	------	0.016	0.082	0.80	------
Do	do	do	25.0	86.7	1.219	0.55	2.31	56.53	101.80	2.43	0.0088	0.002	0.074	1.27	------
Kanturi	*Hemidonax donaciforme.*	Sand cockles	12.0	83.6	2.690	0.97	3.05	217.19	78.44	2.81	------	0.001	0.153	6.18	------
Kuhol	*Ampullaria luzonica.*	Pond snail	76.3	72.2	1.920	0.54	3.25	1658.16	61.00	8.69	------	0.002	0.038	1.29	------
Paros	*Solstellina* (*Psammotea*)	Rayed shells	61.4	87.5	1.392	0.82	1.57	121.14	82.77	8.58	------	0.007	0.021	2.19	------
------	------	Venus clam	6 1	------	2.045	2 05	1.54	100.50	149.95	6.64	------	0.002	0 012	1 16	------
Talaba	------	Oyster	11.8	85.5	1.003	1.68	1.70	146.58	77.31	5.83	0.0403	0.207	0.204	1.67	------
Tulia	*Corbicula fluminea*	Fresh-water mussel	32.4	81.8	0.993	1.65	0.73	175.82	77.31	1.65	0.1691	0.001	0.161	1.15	------
Tulia, luto	do	Fresh-water mussel, cooked	52.0	81.8	0.958	0.95	0.55	122.37	80.05	5.76	------	0.002	0.236	1.11	------

TABLE 3.—*Crustaceans and mollusks*—Continued.

Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion											
				Moisture	Nitrogen	Fat	Ash	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
			Per cent	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
III. THEIR PRODUCTS															
Alamang, bagoong	------	------	100.0	63.3	2.391	1.04	20.69	468.86	228.87	5.37	------	0.010	0.100	1.67	------
Alamang, bastos, bagoong	------	------	100.0	64.1	1.925	0.83	22.05	689.20	397.45	8.87	------	0.008	0.144	1.55	------
Alamang, tuyo	------	------	100.0	21.5	9.030	3.71	11.83	2395.83	472.42	24.11	------	0.032	0.199	7.11	------
Bagoong, isda	------	------	100.0	64.3	2.282	1.01	21.60	535.49	313.00	10.89	------	0.003	0.126	3.84	------
Bagoong, padas	------	------	100.0	55.0	------	1.72	22.83	504.21	435.16	16.59	------	0.006	0.206	3.74	------
Guinamos	------	------	100.0	49.0	4.275	2.51	21.59	819.59	767.73	3.30	------	0.0	0.274	5.04	------
Hipon, tuyo, hibe	------	------	100.0	31.4	8.206	1.83	12.95	603.85	396.49	1.20	------	0.002	0.028	3.53	------

TABLE 4.—*Miscellaneous.*

Ipon	------	------	100.0	61.2	1.393	1.62	23.68	426.60	220.03	2.97	------	0.034	0.174	1.83	------
Talaba, bagoong	------	------	100.0	85.2	0.531	2.45	7.56	138.51	23.01	4.13	------	0.003	0.033	0.33	------
Baksat	*Carcharias* sp.	Shark	88.9	79.9	2.672	1.26	1.36	52.69	179.23	1.69	------	0.035	0.019	2.10	------
Dahonan	*Dasyatis kuhlii*	Blue-spotted sting ray	40.9	79.7	2.926	0.07	1.46	21.72	99.22	tr	------	0.036	0.016	3.40	------
Paging bulik	*Dasyatis uarnak*	Marbled sting-ray.	36.4	82.2	2.292	0.15	1.31	223.06	156.14	0.87	------	0.013	0.050	4.37	------
Pating	*Scoliodon palasorrah.*	Shark, sharp-nosed	------	------	3.827	0.14	1.39	14.24	203.61	1.09	------	0.025	0.033	6.55	------
Pating palikpik, tuyo.	do	Shark, fins, dried	------	14.4	13.101	0.11	1.50	250.59	133.64	4.53	------	0.0	0.060	------	------
Pindanga	*Muraenesox cinereus.*	Silver pike eel	59.0	77.1	------	0.21	1.48	132.52	167.79	0.43	------	0.147	0.038	2.52	------
Binkungan	*Spyrna zygaena*	Hammerhead shark	48.9	78.3	3.222	0.32	1.29	24.99	207.52	0.92	------	0.014	0.031	3.21	------
Pindanga	*Muraenesox cinereus.*	Silver pike eel	73.7	78.3	2.791	0.11	1.37	43.85	219.87	0.85	------	0.034	0.019	2.11	------
Pusit	------	Squid	97.6	75.8	3.118	1.05	1.39	[illegible]	[illegible]	1.01	------	0.019	0.034	3.92	------
Pusit,	------	Squid	97.2	70.8	2.611	1.25	1.03	42.61	173.33	2.21	------	0.008	0.039	4.23	------
Pusit, malaki	------	Squid, large	92.7	83.0	2.104	0.63	1.35	72.03	159.76	0.76	------	0.003	0.004	1.72	------
Pusit, luto	------	Squid, cooked	98.6	77.3	3.339	1.68	1.14	53.90	197.17	1.95	------	0.014	0.027	1.71	------
Pusit, tuyo	------	Squid, dried	------	30.6	9.183	4.49	5.51	49.38	600.35	3.22	------	0.023	0.070	9.03	------

SUMMARY

The proximate mineral and vitamin contents of 166 samples of fish, crustaceans and mollusks are reported in this paper. These samples are the edible species more commonly used by Filipinos. From the results of this study, it may be stated that in general fish and sea foods are dependable sources of protein and niacin and, to a certain extent, of calcium and thiamine.

ACKNOWLEDGMENT

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VALENZUELA, ABELARDO. Composition and nutritive value of Philippine food fishes. Philip. Jour. Sci. 36 (1928) 235.

TABLE 3.—*Crustaceans and mollusks*—*Continued.*

Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion											
				Moisture	Nitrogen	Fat	Ash	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
			Per cent	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
III. OTHER PRODUCTS															
Alamang, bagoong	------	------	100.0	63.3	2.391	1.04	20.69	468.86	228.37	5.37	------	0.010	0.100	1.57	------
Alamang, bastos, bagoong	------	------	100.0	64.1	1.925	0.83	22.65	689.20	397.45	8.87	------	0.003	0.144	1.55	------
Alamang, tuyo	------	------	100.0	21.5	9.030	3.71	11.83	2395.83	472.42	24.11	------	0.032	0.199	7.11	------
Bagoong, isda	------	------	100.0	64.3	2.282	1.04	23.60	535.49	313.00	10.89	------	0.004	0.126	3.84	------
Bagoong, padas	------	------	100.0	55.0	------	1.72	22.83	504.21	435.16	16.59	------	0.006	0.206	3.74	------
Guinamos	------	------	100.0	49.0	4.275	2.51	21.59	819.59	757.73	8.30	------	0.0	0.274	6.04	------
Hipon, tuyo, hibe	------	------	100.0	31.4	8.206	1.83	12.95	603.85	396.43	1.20	------	0.003	0.028	3.53	------

TABLE 4.—*Miscellaneous.*

Ipon	------	------	100.0	61.2	1.393	1.62	35.66	426.69	229.03	2.97	------	0.034	0.171	1.81	------
Talaba, bagoong	------	------	100.0	85.2	0.531	2.45	7.56	118.51	21.01	4.13	------	0.004	0.033	0.35	------
Baksat	*Carcharias* sp.	Shark	88.9	79.9	2.672	1.26	1.36	52.60	179.23	1.69	------	0.035	0.019	4.10	------
Dahonan	*Dasyatis kuhlii*	Blue-spotted sting ray	40.9	79.7	2.926	0.07	1.46	24.72	99.22	tr	------	0.036	0.046	2.40	------
Paging bulik	*Dasyatis uarnak*	Marbled sting-ray	36.4	82.2	2.292	0.15	1.31	223.06	156.14	0.87	------	0.013	0.050	4.37	------
Pating	*Scoliodon palasorrah.*	Shark, sharp-nosed	------	------	3.827	0.14	1.39	14.24	203.61	1.09	------	0.025	0.033	6.55	------
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Pindanga	*Muraenesox cinereus.*	Silver pike eel	73.7	78.3	2.794	0.11	1.37	43.89	218.87	0.85	------	0.051	0.013	2.41	------
Pusit	------	Squid	97.6	75.8	3.113	1.05	1.33	33.35	222.33	1.01	------	0.010	0.031	3.32	------
Pusit	------	Squid	97.2	79.8	2.631	1.26	1.04	42.61	173.33	2.34	------	0.033	0.033	4.23	------
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NOTES ON PHILIPPINE MOSQUITOES, XVII

THE EGGS AND FRESH-INSTAR LARVÆ OF SOME NEOMYZOMYIAS

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THREE PLATES

Group *Neomyzomyia* of subgenus *Myzomyia* is represented in the Philippines by the *leucosphyrus* complex, *kochi, kolambuganensis* and *tessellatus*. These anophelines are widely distributed in the Oriental Region, excepting *kolambuganensis* which seems to be found only in the Philippines.

Leucosphyrus (*s. str.*) has evidently reacted very sensitively to whatever factors cause subspeciation in mosquitoes. Various forms, most of which are very restricted in distribution, have evolved at different points of its range. Three or four of them (*cristatus, riparis*, etc.) seem to be the issue of Philippine conditions; so far they have not been found elsewhere. Others, like *balabacensis*, succeeded in spreading over wide areas separated by large bodies of waters without, apparently, losing their specific or subspecific unity.

On the other hand, the same factors seem to have affected *kochi* and *tessellatus* very slightly. Morphological characters of Philippine *kochi* and *tessellatus* indicate little deviations from those of *kochi* and *tessellatus* in India and Malaya.

Owing to its importance as vector of human malaria, the *leucosphyrus* complex has recently attracted a good deal of attention. Changes in the names or status of some of its forms have been introduced in an effort to clarify their systematic standing. Thus, Reid[1] reduced *leucosphyrus balabacensis* Baisas, 1936, as a synonym of *leucosphyrus leucosphyrus* Dönitz, 1901, and indicated that what the Philippine workers consider the typical form" . . . might be found . . . a subspecies (geographical race) of *leucosphyrus* (*sensu restrictu*) . . . and could be named accordingly." Colless[2] agreed with Reid regarding the Luzon Island form, but provisionally retained the

[1] Reid, J. A. A preliminary account of the forms of *Anopheles leucosphyrus* Dönitz, 1901. Proc. Roy. Entom. Soc. London. Ser. B. 18 (1949) 42–53.

[2] Colless, D. H. The identity of the malaria vector, *A. leucosphyrus*. Indian Jour. Mal. 4 (1950) 378–383.

subspecific status of *balabacensis.* Subsequently, in a study of materials including specimens from the Philippines, which he borrowed for the purpose, he [3] indicated it might be raised to full specific rank. As finally published, however, the subspecific status [4] is retained.

As a result of these revisions, the local forms of *leucosphyrus* are now known as *Anopheles cristatus* King & Baisas, 1936; *A. leucosphyrus balabacensis* Baisas, 1936; *A. l. riparis* King & Baisas, 1936; *A. leucosphyrus* ("Luzon form" Colless, 1956); and *A. leucosphyrus* ("Negros form" Colless, 1956).

At present Philippine workers can say nothing about the systematic positions of the "Luzon and Negros forms." Efforts to obtain more specimens for study since 1953 have been fruitless. Gravid females are particularly needed for the study of eggs, different larval instars, pupæ, and adults that may be raised in the laboratory. More tangible differential characters may be found that way.

The long Sierra Madre Range of Luzon seems to be the breeding grounds of the "Luzon form." It was reported in the north (by Serrano: adults, Cagayan Province), at the central portion (by Baisas, *et. al.:* adults and larvæ, Quezon and Laguna provinces), and near the southern tip (by Mendoza: adults, Camarines Norte Province). But at all points where it was encountered during the last 20 years, it appeared to be rare.

Actually, there are only two known breeding waters. One is at the Llavac jungles some distance away from the road that connects Famy, Laguna Province, and Infanta, Quezon Province. This place is at present off limits to non-military personnel. The other is in upper Molawin Creek, a hundred yards or so beyond the College of Forestry of the University of the Philippines, at the foot of Mt. Maquiling in Laguna Province. While then an employee of the Rockefeller Foundation, the senior

[3] Colless, D. H. In a personal communication (dated January 6, 1953) to Dr. Walfrido de Leon, Director of the Public Health Research Laboratories, Department of Health, Manila, Colless states: ". . . *balabacensis* is, by the way, to be reestablished as a full species . . . in my paper on the group, which I hope to publish soon . . . The Luzon form I am leaving as an underscribed species or subspecies for the attention of the Philippine workers who first established its separate indentity."

[4] Colless, D. H. The *Anopheles leucosphyrus* Group. Trans. R. Ent. Soc. Lond. 108 (1956) 77–116. (Copy received when this paper was still in the press.)

author first found a few larvæ of this mosquito in rock holes and quiet places along the edges of this creek. That was in 1924. In different years since then, many collecting visits were made to this place, and most of the time (rainy season) a few larvæ (occassionally also a pupa or two) were obtained. Breeding was never heavy. Although adults were repeatedly searched for in likely daytime resting places, none was ever taken.

The same negative results were registered in Llavac during a ten-month observation made there by the senior author and his men in 1940–41. No adult was found in daytime harborages, and none was caught in the two traps erected near the road. In fact, hardly did adults of other mosquitoes enter the traps, although there was considerable breeding of jungle culicines all around in treeholes, streams, ground pools, leaf axils, and pitcher plants. Heavy breeding of *Anopheles aitkeni bengalensis, Anopheles insulæflorum;* light breeding of *Anopheles barbirostris* (complex); and very occasional breeding of *Anopheles acaci* were also noted in jungle streams, but their adults must have been very wild, for none was ever seen, much less captured in the open or by trapping.

In two separate occasions, breeding of *leucosphyrus* was noted in a temporary, drying stream at Llavac. But in both cases, very few larvæ (half a dozen or so) were all that could be taken in spite of very thorough dippings. Some of these larvæ were reared to adults.

In 1937 to 1938, however, a few adult *leucosphyrus* were caught in carabao-baited traps at two very widely separated points in the immediate vicinity of the Sierra Madre Range, one in Camarines Norte Province and the other in Cagayan Province. About half a dozen females were taken by Dr. J. B. Mendoza in a carabao-baited trap in Panganiban, Camarines Norte; two were captured in a similar trap in Gattaran, Cagayan Province, by Mr. Moises Serrano. From both places the catches were made at different times. Mr. Serrano got one adult after the other at an interval of weeks; only one or two at most were taken each time at long intervals in Camarines Norte. The breeding waters of *leucosphyrus* in both places were not found. Presumably they were in the forests some distance away from the traps. The traps were located inside or very close to groups of houses.

The foregoing evidences would seem to indicate that in its natural jungle haunts (like Llavac), the Luzon form of *leucos-*

phyrus does not prefer to feed on either man or his domestic animals. (Different domestic animals, including a carabao, were used as baits in one of the traps at Llavac; the other trap had only man as bait night and day).

Cristatus, one of the two Mindanao forms of *leucosphyrus*, is even more difficult to find. In 1953 at the instance of Mr. Colless, Dr. Walfrido de Leon, Director of Public Health Research Laboratories, requested Dr. Gaudencio R. Villanueva, then malariologist supervisor over Mindanao to ask his men to collect *cristatus* and *reparis* specimens. However, Villanueva himself decided to go to the known breeding places of these mosquitoes in Kolambugan. He was accompanied by Mr. Francisco Guinto who knew the particular streams where years ago he had collected the species. Unfortunately, the breeding places had disappeared, because all the forests around Kolambugan had been cut for lumber and other uses.

Small rock holes along the banks of only one particular stream—a branch of Titunod Creek—in a small village called Titunod in Kolambugan, Lanao Province, were the only breeding waters of *cristatus*. They were discovered by Mr. Domingo Santiago in 1930 while vainly searching for larvæ of *kolambuganensis* for Dr. Paul F. Russell of the Rockefeller Foundation. Over a year later the senior author of the present paper was sent to Mindanao to collect *Anopheles parangensis, kolambuganensis*, and other species found only in that southern island for Dr. W. V. King, senior entomologist of the United States Department of Agriculture. The Rockefeller Foundation sent Dr. W. V. King to the Philippines to study local anophelines. After many fruitless attempts in different parts of the then virgin forests of Kolambugan, the senior author finally collected a few *kolambuganensis* larvæ in a very deep portion of the jungles. Closer to the town proper of Kolambugan, but still covered with virgin forests, he also found a rather heavy breeding of *leucosphyrus riparis* in a stagnated portion of a drying temporary stream. Very close to this point, several weeks later, he also found some *kolambuganensis* larvæ along with numerous larvæ of *aitkeni bengalensis* and *insulaeflorum* in the upper forested portion of Kolambugan Creek. *Kolambuganensis* breeding was not actually mixed with those of the latter two species, but occurred a little further upstream inside the forests. In the open portion of this creek, there were many larvæ and some pupæ of *minimus flavirostris, maculatus, barbirostris* complex,

ludlowi and other common species. The rock holes where *cristatus* was breeding in Titunod were visited weekly. A few larvæ and one to three pupæ were taken during each visit.

A third collecting trip of about two months' duration was again made to the same place by the senior author, this time accompanied by Mr. Francisco Guinto. Weekly collections of larvæ were undertaken. The larvæ were isolated and reared to adults individually in the town of Kolambugan, and the larval and pupal skins, mounted. The collections were made for Dr. Paul F. Russell and for the Division of Malaria, Philippine Department of Health.

Adults of *cristatus* and *riparis* have not been caught wild; their natural haunts are till now unknown. After the liberation, as a gauge to the effects of anti-larval measures in malaria control in the villages immediately outside the boundary of Kolambugan, Doctor Villanueva and his men erected carabao-baited traps. The traps were located within the flight range of *leucosphyrus* and conceivably also of *kolambuganensis*. They did not, however, capture either a single adult *leucosphyrus* of any kind or of *kolambuganensis*.

Headed by Capt. H. Hoogstraal a joint collecting expedition to Mt. Apo in 1946 was undertaken by the Chicago Museum of Natural History and the Philippine National Museum. The expedition brought back an interesting collection of new and already known species of *Topomyia, Tripteroides, Zeugnomyia,* other culicines, *Anopheles lindesayi benguetensis* and some *leucosphyrus riparis*. That was the first time *lindesayi benguetensis* was reported outside the highlands of Luzon. But there was no larva or adult of *cristatus* or *kolambuganensis* in their collections.

None of the many trained personnel of the United States Public Health Service (Malaria Control in the Philippines) in Mindanao and elsewhere in 1947–49 found these species and none of the many malaria control men of the Philippine Department of Health scattered throughout the Philippines since 1950 has taken them. It was only in the course of a mosquito survey and collecting trip undertaken in Mindanao by the senior author in 1953 that Mr. Felix V. Dantis (who participated in this survey) obtained two third-instar larvæ of *kolambuganensis* from a forest creek near the road between the provinces of Oriental Misamis and Agusan.

Balabacensis seems to be much more numerous and more commonly associated with man and his domestic animals than any of the other forms of the local *leucosphyrus*. So far as is known in the Philippines, *balabacensis* is found only in Palawan and neighboring smaller islands, specially Balabac. These points would seem to be the farthest northern limits of its range. The species, according to Colless (1950), is widely spread in Borneo and is found as far as Burma.

Mr. Francisco Guinto obtained the first specimens of *balabacensis* in the Philippines. That was in 1932 when Dr. Paul F. Russell sent him on a collecting trip in Palawan and Balabac islands. He reported heavy breeding of this mosquito in slow-flowing creeks which were partly exposed and partly covered by forests. Breeding in either portion was similarly heavy, thereby indicating that this species is not strictly sylvan in habits. About the same conditions were noted by him concerning breeding of *balabacensis* in Palawan. He brought back to Manila many adult *balabacensis* reared individually from isolations he made in Balabac and Palawan, but he made no observation on the natural habits of the adults.

The first to catch wild adult *balabacensis* was a lady physician of the Division of Malaria assigned in Palawan in 1948 to 1949. Dr. Milagros de Guzman who had had training in malaria work in the United States, caught in carabao-baited traps in Puerto Princesa and in Iwahig Penal Colony a few female *balabacensis*. Only one or two were captured on each night of trapping. These were sent alive to Manila by air. Only two survived the trip, one of which laid more than half a dozen eggs in the Manila laboratory of the Division of Malaria. Apart from *balabacensis*, Doctor de Guzman was also the first to catch and to send to Manila alive gravid *gateri*. The authors thus obtained the eggs and first-instar larvæ of this species.[5] Later, when she was transferred to the Mountain Province, Doctor de Guzman also was the first to send gravid *ludlowi* the eggs of which had floats. The kind of *ludlowi* eggs described and illustrated by Urbino[6] had no floats.

[5] Baisas, F. E., and A. Ubaldo Pagayon. Notes on Philippine mosquitoes, XVI. Genus *Tripteroides*. Institute of Science and Technology, Manila. Mono. 2 (1952) 198 pp.

[6] Urbino, C. M. The eggs of some Philippine *Anopheles*. Mon. Bull. Bur. Health. 15 (1936) 262–275.

In 1953, through an arrangement made with Dr. Alfredo Leoncio, who succeeded Doctor de Guzman in Palawan, two traps were erected in Iratag, a small village of Puerto Princesa immediately outside the Iwahig Penal Colony. One of the traps was baited with man and the other with a carabao. The observations have since been discontinued from lack of personnel. In the few nights of trapping, *balabacensis* were caught in both traps, seven being the highest night catch in the human-baited trap. Adults of *balabacensis* were also caught inside houses at daytime in the barrios of Irawan and Irisan, Puerto Princesa.

Doctor Leoncio lately (June and July, 1955) caught adult *balabacensis* (one a night in two separate nights) in a carabao-baited trap at Panacan, Palawan.

When the senior author and Mr. F. V. Dantis went to Palawan in 1953, Doctor Leoncio showed them a temporary creek near the newly constructed provincial hospital outside Puerto Princesa, where he found breeding of *balabacensis*. The place is actually a second- or third-growth forest, hardly half a kilometer away from the very center of the town. The stream was dry at the time, but it was not at all like the heavily forested streams and rock holes where *cristatus* or *riparis* of Mindanao or the Luzon form of *leucosphyrus* breeds.

The evidently closer affinity of *balabacensis* to man and his domestic animals and its more prolific breeding in situations not far from human habitations strongly indicate the possibility that in Palawan and Balabac it plays a part in the transmission of malaria. (The authors tried to prove this by dissection; but of the small number available for the purpose, none was positive). Colless (1950) has shown the importance of *balabacensis* in the transmission of malaria in Borneo. However, even if it should prove to be as dangerous in Palawan and Balabac, *balabacensis* would still be less of a public-health problem than *minimus flavirostris*; *balabacensis* has a marked seasonal appearance (August to December) and its density at the height of its breeding seems far less than the density of the continually present *minimum flavirostris*.

THE EGGS

(Plate 1)

Most of the studies on eggs of Philippine *Anopheles* undertaken by the authors (unpublished) were in 1950. Since then the work has been desultory and carried on only whenever their

more important assignment in malaria control allows. The eggs of most species were obtained, studied, recorded, drawn, and in many cases, adults were raised from these eggs in the laboratory. Only the rare and not easily available species were lacking. Thousands of eggs were examined under low magnification to study the general character of the species and to detect possible abnormalities. For measurements and detailed study of characters, however, only ten eggs from each batch were used. These were carefully selected under low magnification in order that the smallest, the largest, and the most common might be properly represented. Usually the proportion was two eggs representing the smallest, two representing the largest, and six, the most common.

The wings of those that laid eggs were measured. They were in all 46 *kochi* and 35 *tessellatus* (mostly from Mindanao and Palawan, some from Luzon and a few from Mindoro), and one *balabacensis* (from Palawan). The wings of the lone *balabacensis* were about 3.66 mm long; those of *kochi* varied from 2.60 to 3.70 mm while those of *tessellatus* ranged from 2.40 to 4.87 mm.

Judging from the measurements of the wings and of the eggs, it is evident that neither do large individuals necessarily lay large eggs nor small mothers, small eggs. In fact, it is about as usual to find within any species large mothers laying relatively small eggs and small mothers, comparatively large eggs. Examples: the largest *kochi* with wing measurement of 3.70 mm laid 113 eggs that varied from 0.499 to 0.522 mm in length; smallest with wing 2.60 mm long, laid 61 eggs, measuring from 0.530 to 0.554 mm long. An unusually large *tessellatus,* having wings about 4.87 mm long, laid 87 eggs that were 0.484 to 0.515 mm long; while an unusually small mother of this species (wing length: 2.40 mm) laid 18 eggs 0.499 to 0.530 mm long.

The number of eggs in a batch does not necessarily affect the sizes of the individual eggs, although there are some cases where a small batch is correlated with larger eggs. Very often, the average measurements of the eggs in a large batch are about the same as those in a small batch.

The differential characters between eggs of closely allied species are in many cases more marked than the differences in the larval and adult stages. Thus, anyone with a fair experience

in mosquito work can easily differentiate the eggs of *subpictus indefinitus* from the eggs of *vagus limosus*, whereas even highly experienced technicians handling anopheline identification for years are often baffled by the overlapping and intermediate characters seen in many caught wild adults of these two species.

The eggs of group Neomyzomyia, subgenus *Myzomyia*.—A discussion of the eggs of Philippine *Neomyzomyia* would not be conclusive, since no eggs of *cristatus*, *riparis*, the "Luzon" and "Negros" forms of *leucosphyrus*, and *kolambuganensis* were obtained. Nevertheless, it would probably be of some help to others who may later attempt this work to know what Philippine workers have found so far; to defer publication of information already gathered till the eggs of every form and species are taken and studied may mean many years of futile waiting.

If the characters commonly found on the eggs of *balabacensis*, *kochi*, and *tessellatus* indicate uniformity in these among eggs of the Philippine neomyzomyias, the group may thereby be distinguished from other groups of subgenus *Myzomyia* even in the egg stage. First, the polygonal network is found on all three. No other known egg of Philippine subgenus *Myzomyia* bears this polygonal network, although it is a general character among eggs of subgenus *Anopheles*. Second, the frill is fairly wide, stands upright, runs in straight or nearly straight line from tip to tip of the egg. Third, the deck, apart from being narrow, is equal or nearly equal in width at all points.

These three kinds of eggs are differentiable from each other either by their gross appearance (low magnification) or by finer details (higher magnification).[7] By their lengths, however, they are not always distinguishable because of a high percentage of overlapping. The illustrations (see Plate 1) were taken from those which differed markedly in sizes.

The egg of *tessellatus* is distinctly more tapering toward either pole than the egg of *balabacensis* or *kochi*. Its frill stands up more "rigidly"; its deck is often narrower; and it

[7] Christophers, quoting Stanton, says the egg of *kochi* does not differ in any detail from that of *tessellatus*. They are referring to Malayan forms, which (as indicated above) evidently differ in some morphological characters from the corresponding Philippine *kochi* and *tessellatus*. S. R. Christophers: The fauna of British India. Diptera 4 (1933) 176.

lacks the boatlike curvature on its upper surface.[8] The egg of *kochi* is stouter than the other two, while the egg of *balabacensis* has relatively the longest space from the floats toward either pole.

At high magnification, the floats of *tessellatus* are comparatively longer either in actual measurement or in relation to the length of the egg itself; these floats are also more widely separated on the upper, as well as on the lower, surface of the egg, as a consequence of which (or *vice versa*), the floats of *tessellatus* are the narrowest among these three. In other words the ridges are shorter than those of *balabacensis* or *kochi*. Float-length differences do not seem to indicate differences in number of ridges. The variations in counts of ridges are about the same in the three species under discussion (see Table 1).

TABLE 1.—*Measurements and other details of the eggs of three neomyzomyias.*

	Anopheles balabacensis (Based on seven eggs)		*Anopheles kochi* (Based on many eggs)		*Anopheles tessellatus* (Based on many eggs)	
	Range	Usual	Range	Usual	Range	Usual
Length of egg in mm	.499–.515	.510	.460–.561	.501	.477–.624	.538
Width of egg in mm	.164–.171	.168	.156–.203	.179	.156–.187	.171
Thickness of egg in mm	.125–.128	.125	.120–.179	.132	.109 .140	.129
Length of float in mm	.281–.312	.291	.203–.406	.308	.250–.463	.367
Width of float in mm	.074–.078	.076	.062–.091	.070	.043–.062	.047
No. of ribs of floats	14– 20	16–	13– 23	19–	14– 25	18–
Dist. of float to ant. pole mm	.094–.140	.117	.062–.156	.118	.062–.140	.088
Dist. of float to post. pole mm	.086–.109	.096	.055–.148	.095	.047–.125	.088
Dist. of float to frill mm	.011–.023	.015	.023–.062	.046	.041–.194	.065
Dist. between floats on up surf. mm	.074–.094	.087	.109–.133	.112	.133–.140	.125
Dist. between floats on lower surf. mm	.074–.078	.076	.047–.081	.069	.070–.109	.085
Widest point of deck tow. ant. pole mm	.016–.031	.023	.023–.055	.011	.016–.047	.027
Widest point of deck at mid. mm	.019–.027	.023	.023–.055	.036	.016–.051	.025
Widest point of deck tow. post. pole mm	.019–.027	.023	.023–.055	.036	.016–.17	.025
Height of frill ant. mm	.019 .031	.025	.016–.039	.023	.016–.031	.018
Height of frill mid. mm	.016–.027	.022	.016–.031	.021	.011–.027	.018
Height of frill post. mm	.019–.027	.024	.016–.027	.020	.016–.027	.019

It was not possible to get other living, gravid *balabacensis* from Palawan for egg-laying in the Manila laboratory. Only one mother lived long enough to lay 7 eggs before she died. This species is apparently not as hardy as the common anophelines. It can hardly survive the air transit from Palawan to Manila, whereas fatality in other species sent with *balabacensis* was very low. On the other hand, 54 mother *kochi* (from Mindanao and Palawan mostly) laid in the Manila

[8] Christophers, S. R. *loc cit.* See Fig. 14–4. Egg of *tessellatus* illustrated has slight downward slope from middle toward tips of upper surface.

laboratory a total of 4,037 eggs; the range in number of eggs being from 51 to 156 a batch; the most common, being about 122 eggs in a batch. Similarly, 36 *tessellatus* (mostly from Mindanao and Palawan also, and some from Mindoro) laid in the Manila laboratory 2,016 eggs, the number to a batch varying from 53 to 142; the most usual, being about 60 eggs in a batch.

The first-instar larvæ.—The general characteristics and the arrangement of hairs of the first-instar larvæ of the three neomyzomyias under consideration are similar to those found on all other known first-instar larvæ of subgenus *Myzomyia* in the Philippines. Group *Neomyzomyia* seems to be differentiable from other Philippine groups of subgenus *Myzomyia* by the frayings of the inner clypeals (H–2). It seems remarkable that such species as *annularis*, and *philippinensis* (as well, apparently, as *maculatus* and *karwari*), in which the inner clypeals of the fullgrown larvæ are highly frayed, do not show any trace of these frayings in the first-instar. Even the plumosity of the outer clypeals (in *annularis* and *philippinensis*) is not indicated in the earliest larval stage.

The types of frayings on the inner clypeals differ in these three. *Balabacensis* has coarser and more frayings from near the base to the tip, *tessellatus* usually has its H–2 [a] merely split into two at the apex, and *kochi* has finer and fewer frayings that are usually confined toward the apex. The position of the postclypeals (H–4) is also diagnostic (see Plate 2); the pair is much more closely separated than H–3 in *balabacensis*, as widely separated as H–3 in *kochi*, equally apart but much farther behind H–3 in *tessellatus*. Other differences: Meta–3 in *balabacensis* is a very fine, simple hair; somewhat coarser in *tessellatus*, but a definitely flattened leaflet in *kochi*. (See Plate 3). Hair 1 of abdominal segment I in all three is a simple, normal, slender hair; 1–II is in the form of a leaflet, but narrow in *tessellatus*, broader in *balabacensis*, and still broader in *kochi;* on III to VI the leaflets are wider and longer

[a] To distinguish the hairs bearing the same numbers on different parts of a larva, the authors found it very useful in teaching beginners to use the prefix "H" for the hairs of the head; the prefixes "Pro–," "Meso–," and "Meta–" for the hairs respectively of the prothorax, mesothorax, and metathorax. On the abdomen, a suffix indicating the segment (in Roman numeral), placed after the designation of the hair (in Arabic), is equally as useful. Thus: the "inner clypeal" is "H–2"; the inner shoulder hair is "Pro–1"; the metathoracic palmate, "Meta–1"; while the palmate and lateral hairs of the fourth abdominal segment are "1–IV" and "6–IV" respectively.

in all of them, but on VII that of *tessellatus* is a normal, slender, simple hair; fairly broad leaflet in *balabacensis,* but a longer leaflet in *kochi.* The comb teeth in *balabacensis* are expanded at the apices, except the most dorsal and the most ventral teeth, which are more or less pointed; more tapering in *kochi* but without a central main point differentiated in size from other serrations; with a distinct and well differentiated central point in *tessellatus.* Pecten teeth in both *balabacensis* and *kochi* have similarly broadened, serrated tips but in, *balabacensis,* the serrations extend to the whole or greater part of one side, whereas those in *kochi* are confined towards the apex. In *tessellatus* the teeth more or less taper toward the apices, and at least one tooth is definitely pointed. Fan (teeth) are broadest and with more serrations in *kochi*; narrower and with less serrations in *tessellatus*; more pointed in *balabacensis.*

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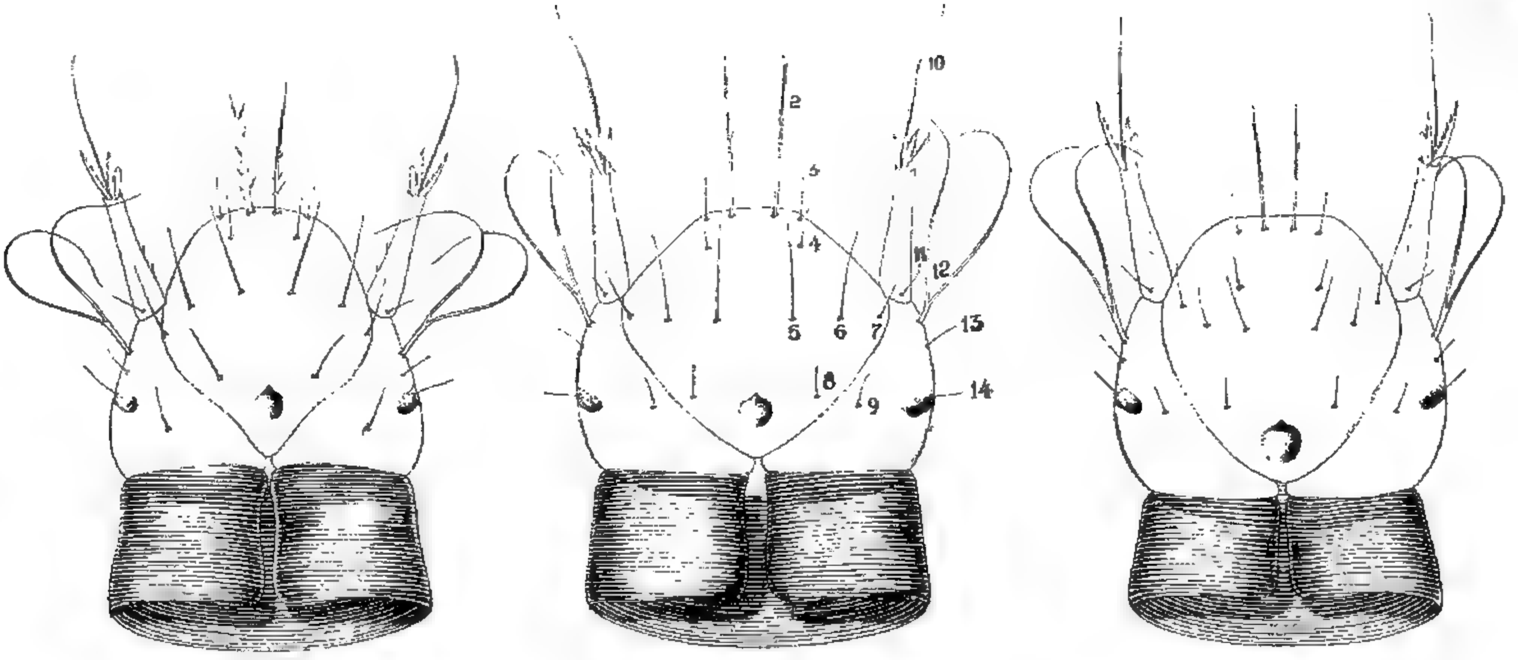
ILLUSTRATIONS

PLATE I. THE EGGS OF THREE PHILLIPINE MEOMYZOMYIAS.



Anopheles balabacensis Anopheles kochi Anopheles tessellatus

PLATE 2. THE HEADS OF THE FIRST-INSTAR LARVAE OF THREE PHILIPPINE NEOMYZOMYIAS.

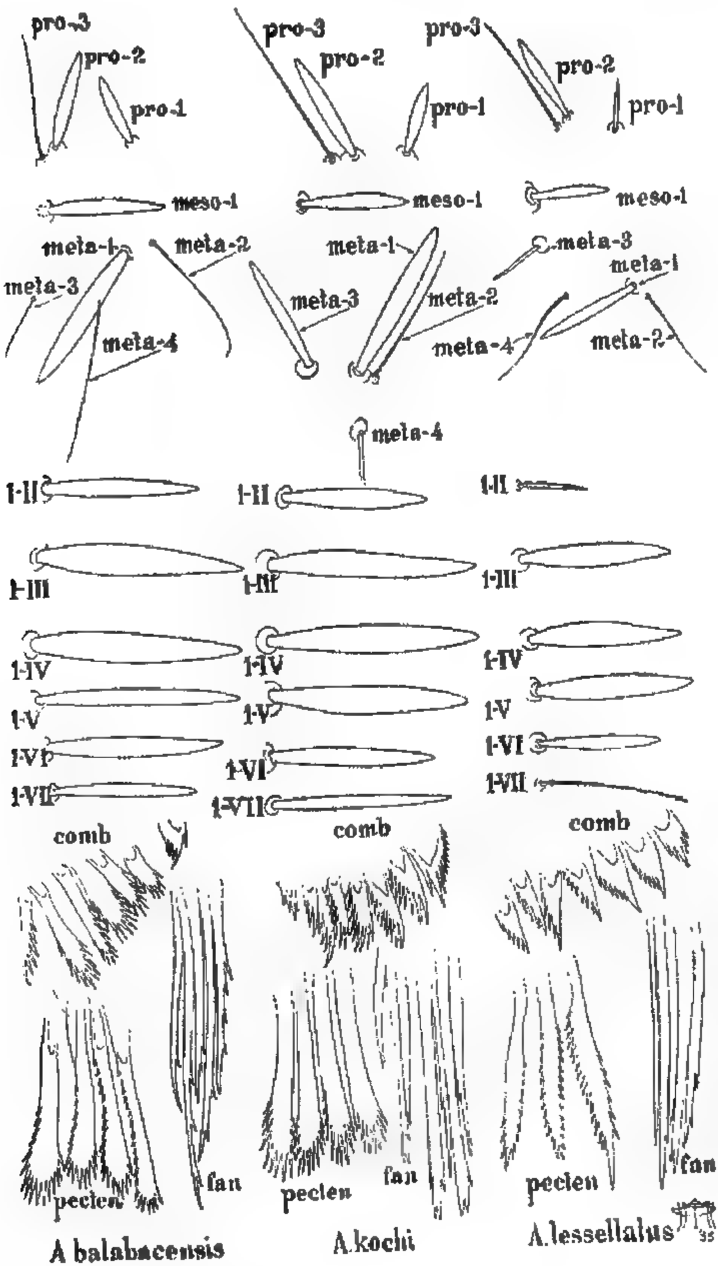


PLATE 3. SOME HAIRS, THE COMB, PECTEN, AND FAN OF FIRST-INSTAR ANOPHELINE LARVAE.

STAMINATE PISTIL IN CROTALARIA SERICEA RETZ.

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ONE TEXT FIGURE

In working with *Crotalaria sericea* Retz. an abnormal flower was observed by the author. The calyx of the flower was somewhat crumpled and was composed of 5 sepals, the corolla, of 5 rudimentary petals; of the ten stamens, the long-anthered 5 were well developed though immature, the other 5 were rudimentary. Abnormality was found in the pistil, there being two apocarpous pistils in place of one. The two carpels were somewhat different in size, one being slightly smaller than the other. They were placed opposite each other. The smaller carpel was first mistaken by the author for a stamen, but on examination

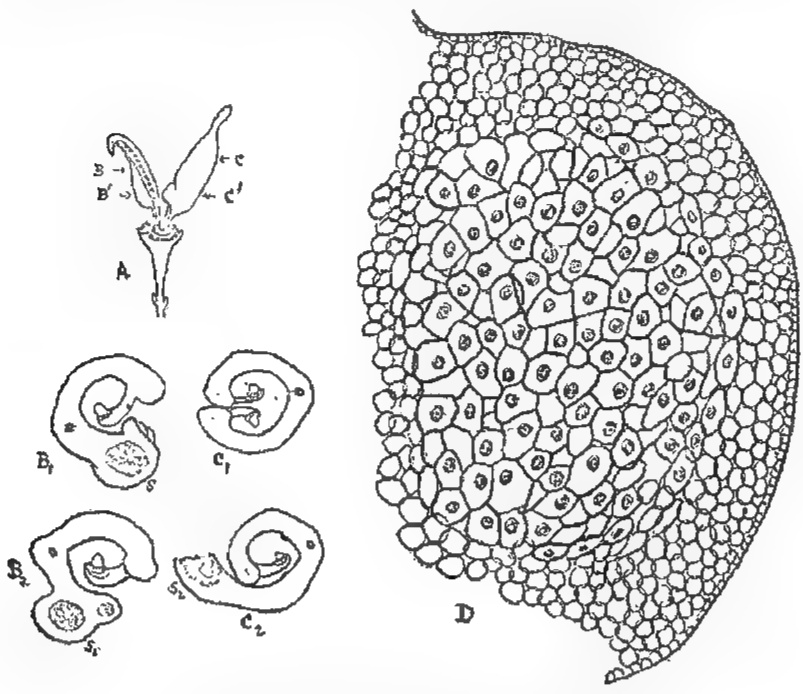

FIG. 1. Staminate pistil in *Crotalaria sericea* Retz.

A, Bicarpellate flower, outer whorls removed. B, B[1], C, C[1] are regions at which transverse sections B B C C are made respectively. S S_1 S_2, margins of the carpel bearing anther-lobes. D, camera-lucida-drawing of part of S_1.

63063——4

with a lens, its carpellary nature was revealed. This carpel was peculiar in having the ovules open like those in a megasporophyll of gymnosperms; the margins did not fuse to enclose the ovules which could be seen with the naked eye. In the larger carpel also the margins did not wholly fuse though they enclosed the ovules inside. Transverse sections of the two ovaries were then made at different heights (Fig. 1, B B^1 C C^1). A second interesting peculiarity was observed on examining the sections under compound microscope. One margin of the smaller carpel was devoid of ovules; instead it contained one (upper region) or two (lower region) circular areas containing immature pollen mother cells (Fig. 1, B_1 B_2 D). Thus the staminal nature was also revealed under the compound microscope. As the flower was young, pollens were not found. But one is sure to identify the structure as an anther-lobe if he observes the true sketches and the camera-lucida-drawing of the flower concerned. The larger carpel also bore a tissue at the base suggestive of an anther-lobe. (Fig. 1, s_2).

Bicarpellate flowers were found in many plants of the family. In *Tounatia dicarpa*(1) it is a normal feature. Bicarpellary flowers were observed in *Inga dulce*,(2) *Saraca indica*(3) *Poinciana pulcherrima*.(4) Multicarpellary apocarpus pistils were found in *Poinciana regia*(5) and *Cicer arietinum*.(6) In several genera of the tribe Ingael,(7) there are more than one carpel. Bi- or tri-furcated pistils were seen in *Sesbania grandiflora*.(8)

Formation of more than one carpel in the family is regarded as a reversion to ancestral type. Some claim it to be an evidence of the foliar theory of origin of carpel. Accordng to Newman,(9) the legume is a single laminar structure which by incurving and adpression of its margins encloses a central cavity; the ovules arise on the incurved margins of this laminar structure. These points are perfectly clear from the open gymnospermous type of carpel and also from closed carpel. The appendicular nature of the carpel is again proved by the transformation of one-half of a carpel into an anther-lobe (or, interpreted in another way, one-half of a stamen is modified into carpel). Transformation of members of one whorl into those of others are observed in many cases, but modification of a carpel or part of it into a staminal structure (or the reverse) is observed for the first time. Observation of this type of abnormality helps to explain a much debated point of origin of carpels, as foliar nature of the stamens have already been proved.

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NOTES ON PHILIPPINE AND OTHER ASIATIC MACHÆROTINÆ (HOMOPTERA)

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TWO PLATES

The present paper is mainly a report on the machærotine spittlebugs in the collections of the College of Agriculture at Los Baños and of the Bureau of Plant Industry at Manila. The writer is greatly indebted to Dean Leopoldo B. Uichanco and Miss Clare R. Baltazar for courtesies received in sending the material used in this report, to Mr. F. L. Yu and Dr. Henry Townes for the loan of a unique specimen from Taiwan and Mindoro, respectively, and to Mr. K. S. Lin for the drawings included in the paper.

Key to tribes, genera, and species known from the Philippines

1. Scutellum clearly subdivided into two by a semitransparent constriction; apical portion (scutellar spine) spinelike, subequal in length or longer than basal portion (scutellum proper) and overhanging tegmina and abdomen; tegmina transparent, with clearly defined venation; pronotum heptagonal, with anterior margin distinct from anterolateral margins. [Tribe Machærotini (Stål), 1866; Genus *Machærota* Burmeister, 1835] 2

   Scutellum never so subdivided, apical portion triangular, never spinelike and never overhanging tegmina and abdomen; tegmina nontransparent, with poorly recognizable venation; pronotum pentagonal, with anterior margin inseparable from anterolateral margins. [Tribe Hindolini (Baker), 1927] 8

2. Body in profile with maximum height of scutellum a little less than length of head and with maximum height of pronotum (excluding lateral slope) only about a third of the longest axis of an eye. Mindanao .... *M. attenuata* (Baker), 1927. ♂.

   Body in profile with maximum height of scutellum much greater than length of head and with maximum height of pronotum (excluding lateral slope) much more than half the longest axis of an eye........ 3

3. Median cell as long as maximum width of tegmen; maximum height of scutellum proper in profile only one-fourth length of scutellar spine (measured from center of semi-transparent spot at base); spatulate sulcus about two-thirds as long as scutellum proper. Luzon. *M. fusca* Baker, 1919. ♀.

   Median cell much shorter than maximum width of tegmen; maximum height of scutellum proper in profile at least one-third length of scutellar spine 4

4. Scutellum proper in profile with maximum height subequal to length; spatulate sulcus about two-thirds as long os scutellum proper; ocelli a little nearer to median line of head than to eyes. Luzon.
M. philippinensis Baker, 1919. ♂ ♀.

Scutellum proper in profile with maximum height much less than length; spatulate sulcus only about half as long as scutellum proper; when more than half as long as scutellum proper, then ocelli as near to median line as to eyes 5

5. Body dark chocolate brown; pronotum in profile posteriorly strongly swollen, where the maximum height is almost twice as anterior height. Mindanao .... *M. mindanaensis* (Baker), 1927. ♂ ♀.

Body whitish to brownish yellow; pronotum in profile posteriorly never strongly swollen but with anterior height subequal to posterior height 6

6. Ocelli as near to median line of head as to eyes; scutellum proper practically as long as pronotum. Luzon.
M. luzonensis Schmidt, 1907. ♀.

Ocelli much nearer to median line than to eyes; scutellum proper distinctly longer than pronotum 7

7. Head in dorsal aspect with median line distinctly longer than an eye and with anterior and posterior margins of tylus clearly nonparallel; median black marking on clypeus much longer than and as broad as an eye; pronotum yellow, with 5 brownish red longitudinal markings. Luzon, Leyte, Mindanao, Palawan.
M. ensifera Burmeister, 1935. ♂ ♀.

Head in dorsal aspect with median line and eye subequal in length and with anterior and posterior margins of tylus almost parallel; median black marking on clypeus as long as and only about one-third as broad as an eye; pronotum practically uniformly pale greenish yellow, never with brownish red markings. Luzon.
M. virescens sp. nov.

8. Cubitus of tegmina distant from claval suture and almost straight corium with 3 pre-apical cells; scutellum shorter than pronotum; head but slightly narrower than pronotum. (Genus *Hindola* Kirkardy, 1900). Luzon .... *H. luzonensis* Baker, 1927. ♂.

Cubitus of tegmina lying, for some distance at middle, on claval suture, strongly curved, the base and apex being distant from the same suture; corium with 2 pre-apical cells; scutellum a little longer than pronotum; head scarcely broader than half the pronotum. (Genus *Serreia* Baker, 1927). Mindanao, Luzon.
S. notabilis Baker, 1927. ♂ ♀.

MACHÆROTA VIRESCENS sp. nov. Plate 1, figs. 1-4; Plate 2, fig. 9.

Agoo, La Union, August 11, 1953 (C. R. Baltazar), 1 ♂. Holotype, in collection of the Bureau of Plant Industry at Manila.

Male.—Body yellowish white, slightly tinged with greenish, particularly on abdomen. Rostrum brownish, apically black. Clypeus basally with a black, elongataly ovate median marking,

with maximum breadth subequal to inter-ocellar space; obliquely transverse clypeal bands faintly tinged with brown. Antennal segment II dull brown. Pronotum anteriorly with four hairless, slightly depressed, finely, densely punctate, creamy yellow spots. Lateral scutellar surfaces brownish yellow, with a broad oblique, poorly defined, whitish stripe extending from anterior margin to base of spatulate sulcus strongly compressed posterior border and strongly recurved inferior border whitish and separated from reticulate-punctate area by a piceous, depressed line; outer surfaces of spatulate sulcus also whitish, with two brown spots at each side near apex. Metanotum yellowish red. Tegmina clear hyaline, apically pale yellowish; vannal lobe with a whitish median stripe at base; jugal lobe blackish; veins more or less yellow, with a few exceedingly minute, brownish, setigerous spots. Wings hyaline, vannal lobe blackish, veins dull brown. Legs a little darker than pronotum, with black spines and tarsal claws. Hairs yellowish, short, sparse.

Head (Plate 1, fig. 1) in lateral aspect anteriorly not raised and scarcely swollen. Anteclypeus swollen, coarsely shallowly punctate, not keeled. Clypeus also swollen and not keeled, but rather smooth and at either side with eight obliquely transverse brownish bands which are slightly depressed, shortly and very thinly haired and are traversed by numerous short, fine striæ. Tylus (Plate 1, fig. 2) short, finely, shallowly punctate, laterally finely striated, discally broadly, shallowly depressed. Vertex distinctly more raised than tylus. Lateral frontal area in dorsal aspect anteriorly distinctly broadened. Pronotum (Plate 1, fig. 3) with coarse, brown, reticulated punctures; lateral margin sharply marked off and slightly recurved, weakly concavely curved ante-humerally and a little less weakly so post-humerally; oblique ridge inside humeral angle wanting; median keel anteriorly well developed, posteriorly scarcely recognizable. Dorsum of scutellum (Plate 1, fig. 4) as coarsely reticulate-punctate as pronotum, but reticulation less evident; median line feebly carinated at apical third spatulate sulcus deep, moderately broad, gradually narrowed towards apex, and in lateral aspect, with lateral margins scarcely explanate, almost vertical. Lateral scutellar surfaces as coarsely reticulate-punctate as on dorsum. Scutellar spine (Plate 1, fig. 1) in profile weakly curved, and a little shorter than tegmen. Median cell of tegmina long, about 37 by 125, broadest near middle; claval vein simple. Femora I and II weakly compressed

bilaterally, scarcely sulcated; femora III strongly so; basitarsi III a little shorter than terminal tarsomeres put together (ca. 25: 30). Anal segment (Plate 2, fig. 9) in profile shorter than anal style. Length of body to abdominal apex about 3.5 mm, to apex of tegmina or of scutellar spine 6.0 mm.

Female.—Unknown.

At first sight this Agoo specimen appeared to represent a general form of *M. ensifera* Burmeister. From the latter species, it can be easily separated, besides a much paler color pattern, by differently shaped head in dorsal aspect, lower scutellum in profile, less curved scutellar spine and strongly developed genital segment (Plate 2, fig. 9). In color pattern, *M. virescens* stands near *M. luzonensis* Schmidt. As described by Schmidt (1907) and illustrated by Baker (1919), the ocelli in the latter species, however, are still closer to eyes, pronotum longer and scutellum in profile more raised.

MACHÆROTA ENSIFERA Burmeister, 1835. Plate 2, fig. 10.

LEYTE, Malaa, 100 m, May, 1952 (C. R. Baltazar), 1 ♀.

LUZON, Batangas, Cuenca, February, 1954 (P. Feliciano), 1 ♀; Quezon, Gumaca, May, 1953 (P. Cortes), 1 ♂; Manila, March, 1951 (P. Feliciano), 2 ♂ ♂; Manila, August and October, 1953 (C. R. Baltazar), 1 ♂, 1 ♀; Mt. Maquiling, 50 to 200 m, February and August, 1948, also March, 1949 (A. Campos, P. Catalen & C. R. Baltazar), 4 ♀ ♀. Nueva Vizcaya, Bagabag, 206 m, April, 1954 (S. M. Cendaña), 2 ♂ ♂, 1 ♀. Manila is the type locality of the species.

MINDORO, Calapan, August, 1952 (Townes family), 1 ♂.

It may be noted that, out of the fifteen specimens studied, seven are with apically forked, four with simple claval vein, whereas in the remaining four specimens, it is forked at one side and simple at another. When forked, the inner branch is, not as other veins, hairless and impunctate (this is also true for *M. philippinensis*). ♂ abdominal apex as in Fig. 10.

This is a species "abundant throughout the Philippine Islands" (Baker, 1919), and is known as a minor pest of *Gossypium* spp.

MACHÆROTA PHILIPPINENSIS Baker, 1919. Plate 2, fig. 11.

LUZON, Mt. Maquiling, 70 to 290 m, February and August, 1948, (J. Gutierrez, M. Ilaga, C. Juliano, & C. R. Baltazar), 1 ♂, 3 ♀ ♀; Mt. Maquiling, August, 1953, on *Pipturus* (C. R. Baltazar), 2 ♀ ♀.

The species is known only from and is "common" in Mt. Maquiling and Los Baños. Its host-plant has not been previously noted. The claval vein in all females listed above is forked, but simple in the unique male. The shape of scutellum in profile is the most distinctive character of the species. ♂ abdominal apex as in Plate 2, fig. 11.

MACHÆROTA COOMANI Lallem., 1942

Machærota confirtissima MAA, [Treubia 20 (1949) 18. nom. nud.] (*syn. nov.*).

The scutellum (incl. its terminal spine) of this species is so variable that the writer (1949) was forced to recognize 5 formæ individuale and *M. confirtissima* was once assumed to be a distinct species. The name unfortunately crept into the manuscript and has to be deleted since it is nothing more than an extreme variety.

MACHÆROTA EXTENSA sp. nov. Plate 1, figs. 5–6, Plate 2, figs. 7–8.

TAIWAN, Pianan, nr. Taitung on the E. coast, September 3, 1954 (F. L. Yu), 1♀, in author's collection.

Female.—Black. Rostrum (basally) and pronotum (posteriorly) a little tinged with chestnut brown. Antennal segment I apically yellow. Scutellum proper dull chestnut brown, with the usual whitish markings on lateral surfaces, posterior margin (in lateral aspect) and at the base of posterior process. Metasternum mainly yellow. Tegmina hyaline, apical cells, apical margin and claval appendix richly stained with yellow; veins brownish black, marginal vein at tegminal apex as well as claval vein reddish brown, with dull brown dots. Wings hyaline, brownish at extreme base, slightly infuscated at vannal lobe. Hairs silvery, long, dense and recumbent.

Head (Plate 1, fig. 5) in lateral aspect anteriorly distinctly raised and swollen. Anteclypeus deeply, confluently punctate, medially feebly keeled and minutely transversely striated. Clypeus smooth, shining, broadly and very weakly keeled at middle, densely, deeply punctate at front, and with 9 horizontal, densely-haired, impressed lines at either side, with interspaces of such lines alutaceous. Tylus (Plate 1, fig. 6) alutaceous, discally extensively, shallowly depressed, anteriorly a little raised and distinctly convexly curved. Vertex medially swollen and transversely striated, laterally strongly sloping downwards; lateral frontal areas anteriorly not widened. Pronotum (Plate 2, fig. 7) sharply reticulate-punctate, and as usual, with 4 roundish, alutaceous, hairless depressions near anterior margin; antero-

lateral margins sharply edged (except at extreme base), slightly explanate, but not recurved; humeral angles with a well developed, oblique, ental ridge; postero-lateral margins exceptionally short, strongly concavely curved, distinctly explanate; median keel complete, but posteriorly less prominent. Scutellum proper (Plate 2, fig. 8) as in pronotum, sharply reticulate-punctate, basally weakly keeled; spatuate sulcus exceptionally long, broad, deep, coarsely, shallowly, transversely reticulated, and in lateral aspect, with the lateral margins very strongly, horizontally explanate. Scutellar spine (Plate 1, fig. 5) in profile apically extending about to the same level as tegminal apices. Tegmina with simple claval vein; median cell short, about 50 by 115, broadest at basal third. Femora weakly sulcated, traversed by numerous, fine striæ. Anal segment (Plate 2, fig. 12) in profile subequal in length to anal style, apically not raised. Length of body to abdominal apex about 5.0 mm, to tegminal apex 7.0 mm, to apex of scutellar spine 7.5 mm.

Male.—Unknown.

In the structure of scutellum, this species appears to be allied to *M. exaggerata* Maa (Tonkin) and *M. philippinensis* Baker (Luzon). The distinctly incised postero-lateral pronotal margin, ... very long tylus as well as spatulate sulcus in combination with the presence of a kell at base of scutellum, however, readily differentiate it from its congeners. In general appearance, it also somewhat resembles *M. formosana* Kato, but in the latter species, the head, pronotum and basal half of scutellar process are "finely" punctate, the scutellum in profile is much lower, and the body including tegmina is only 5 mm long. The specific name *extensa* refers to the median keel and spatulate sulcus of the scutellum.

ILLUSTRATIONS

Plate 1

Fig. 1. *Machærota virescens* sp. nov. ♂. Head, pronotum and scutellum in lateral aspect.

2. *Machærota virescens* sp. nov. ♂. Head in dorsal aspect.
3. *Machærota virescens* sp. nov. ♂. Pronotum in dorsal aspect.
4. *Machærota virescens* sp. nov. ♂. Scutellum proper in dorsal aspect.
5. *Machærota extensa* sp. nov. ♀. Head, pronotum and scutellum in lateral aspect (in same scale as Fig. 2).
6. *Machærota extensa* sp. nov. ♀. Head in dorsal aspect (in same scale as Fig. 2).

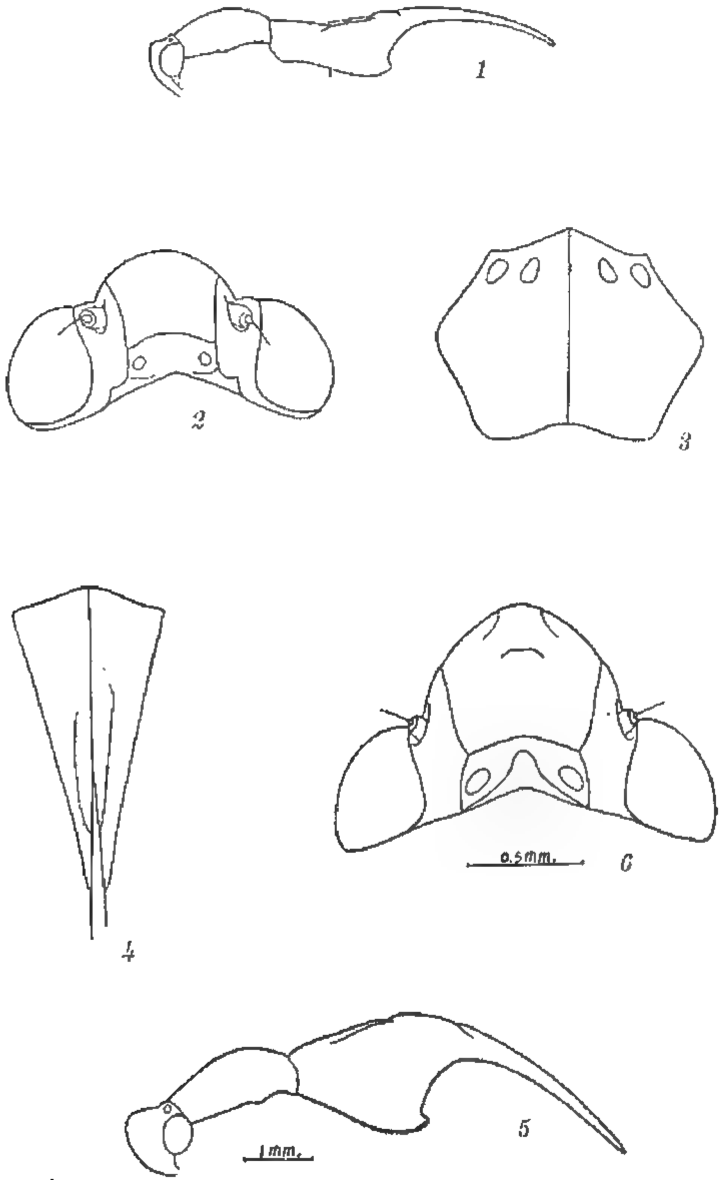
(Plate 1, figs. 3 and 4 and Plate 2, figs. 7 and 8, all in same scale.)

Plate 2

Fig. 7. *Machærota etxensa* sp. nov. ♀. Pronotum in dorsal aspect.

8. *Machærota extensa* sp. nov. ♀. Scutellum proper in dorsal aspect.
9. *Machærota virescens* sp. nov. ♂. Abdominal apex.
10. *Mochærota ensifera* Burmeister, ♂. Abdominal apex.
11. *Machærota philippinensis* Baker, ♂. Abdominal apex.
12. *Machærota extensa* sp. nov. ♀. Abdominal apex.

(Figs. 9 to 12, all in same scale.)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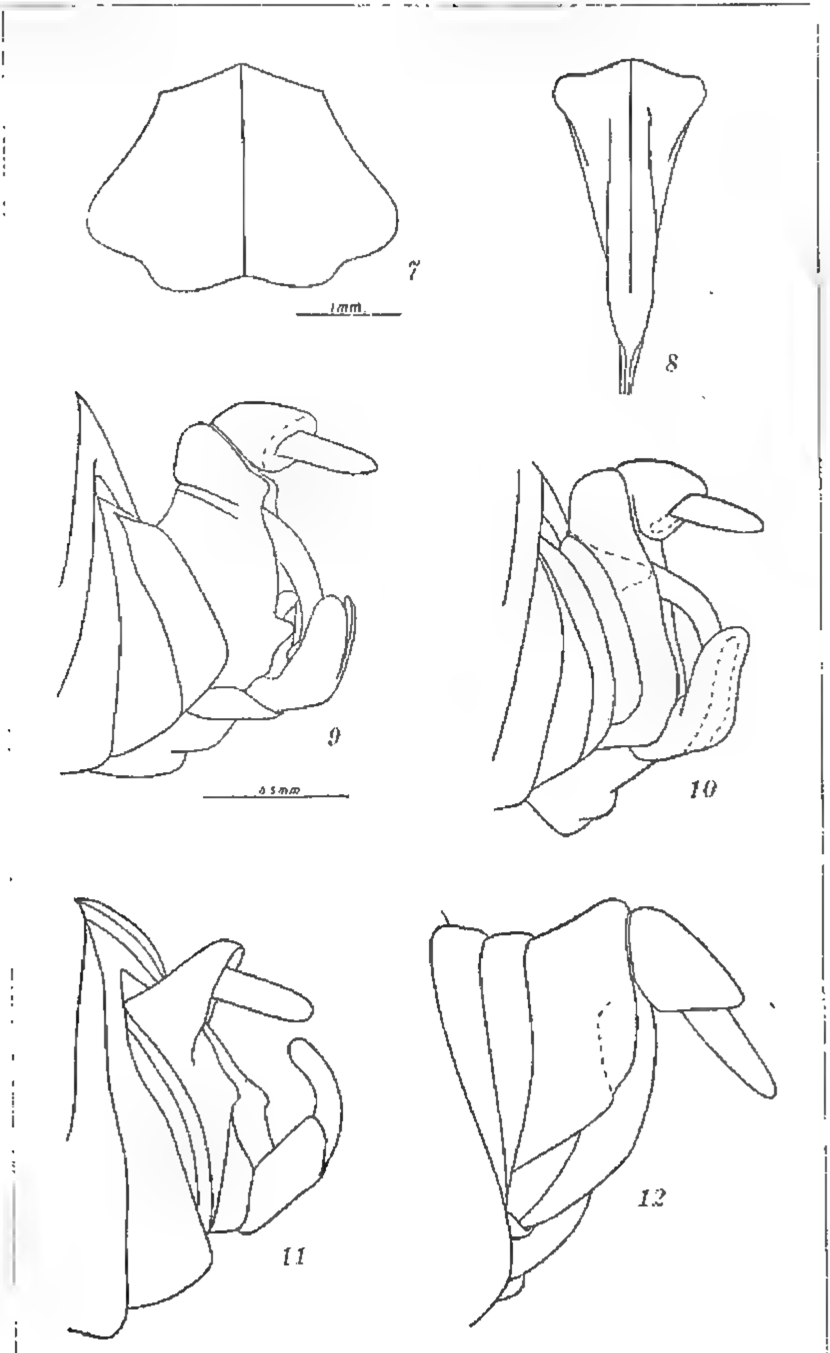

PLATE 2.

THE EXTRA-CORPOREAL HATCHING OF EMBRYONATED OVA OF TRICHURIS VULPIS (FROELICH, 1789)

By L. M. Yutuc
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ONE PLATE

The present report is the outcome of three series of trials on the artificial hatching of the embryonated eggs of *Trichuris vulpis,* commonly known as whipworm recovered from dogs admitted in the Clinics of the College of Veterinary Medicine, University of the Philippines, Diliman, Quezon City. This investigation was deemed necessary because, firstly, no work of this nature has so far been carried in the Philippines; and, secondly, a paucity of literature dealing on the subject exists elsewhere.

The bulk of the data hereto presented have already been communicated in abstracts* in the meeting of the American Society of Parasitologists and of the American Association for the Advancement of Science held in December, 1955, at Atlanta, Georgia, United States of America.

MATERIALS AND METHODS

The eggs were collected in sufficient amount from the excrements of infected dogs by sedimentation and floatation using super-saturated salt solution. These were placed in six-centimeter-diameter Petri dishes with tap water and under room temperature for embryonation. The water was changed at frequent intervals. At least, three days were allowed to pass before using the embryonated eggs for hatching purposes (Plate 1, fig. 1). Paired Petri dishes with enough number of embryonated eggs were used for each trial. The tap water medium was carefully pipetted from each Petri dish and then replaced with Locke's solution [1] in the amount of five cubic centimeters for each culture. To one of the Petri dishes three to five drops of dog bile was added, stirred and incubated along with the other at 37 to 39° C. Two series of ten trials each were carried out. In the third series, instead

* See Jour. Parasit. 41 (1955) 46–47.

[1] Prepared by Metro Laboratories Inc., Manila.

of the dog bile, sodium dehydrocholate (dycholium)[2] was employed in the amount of one to three cubic centimeters of a twenty per cent concentration, along with the Locke's solution. All cultures were contaminated with fecal debris and bacteria, and in a great majority of them overgrowths of fungus and ciliate occurred in addition. Observations were made daily with the low-power objective of a compound microscope using cover-slip preparations. In each observation made at least one hundred embryonated eggs were counted and percentage hatch determined. The latter was based mainly on the presence of empty shells. Ova noted hatching were considered as hatched in spite of the fact that the embryos were only partially out of the eggs. In most instances the embryos were even dead.

The pH of the cultures was checked. In the first series a random determination was carried out, but in the second and the third series each culture was tested for pH concentration.

RESULTS AND DISCUSSION

In the initial series of ten trials, the first trial yielded 25 per cent hatch; the second, 28 per cent; and the third, 26 per cent. In the fourth and the seventh through the ninth no hatch was observed, but in the fifth, one per cent was observed, in the sixth, 4.8 per cent, and in the tenth, three per cent. Only in one control (Locke's solution) was one empty shell noted in this series.

In those that failed to hatch, the pH was 5.6 for the culture with bile and 6.7 for those in the Locke's solution. In those where hatching took place the pH was 6.0 in the bile-Locke's solution and in the Locke's solution 6.8.

The above series was repeated and the results are condensed in Table 1. In the third series of ten trials, dycholium, instead of bile was used. The results are presented in Table 2. Although the results of the first two series are not identical, the general trend of higher hatch in the bile-Locke's solution than in the Locke's solution is aptly shown. Analysis of Table 1 also shows that the pH of the culture does not seem to influence the percentage rate of hatching. The three highest percentage of hatch are noted in Trial numbers 4, 6, and 7, being 20.30,

[2] Prepared by Societé Nouvelle d'Applications Thérapeutiques (S. A.), 98 Rue de Sévres, Paris VII; obtained locally from La Estrella del Norte, Manila.

TABLE 1.—*Hatching record of T. vulpis embryonated ova in cultures of bile-Locke's and Locke's solutions.*

Trial number	Bile-Locke's solution: Hours after preparation of culture, Percentage: 24	48	72	pH	Remarks	Locke's solution: Hours after preparation of culture, Percentage: 24	48	72	pH	Remarks
1	0	0.66	....	6.3	Abundant growths of fungus and ciliates.	0	1.43	....	6.8	Abundant growths of fungus and ciliates.
2	1.00	1.00	....	6.2	....	1.00	1.00	....	6.6	
3	0	0	....	6.7	....	0	0	....	7.0	
4	4.00	20.30	0.15	6.6	Abundant growth of fungus and ciliate.	0	0	0	6.8	
5	1.71	4.76	0.93	6.7	Light growth of fungus and ciliate.	0	1.71	3.[illegible]0	7.3	Light growth of fungus; numerous cysts of ciliate.
6	2.00	13.00	....	4.5	Do.	2.00	1.50	....	6.6	do.
7	7.85	4.54	....	6.1	Tap water one empty shell; heavy growth of fungus; few ciliates, numerous cysts.	2.96	0.94	....	6.9	Tap water four empty shells; occasional ciliates, numerous cysts and heavy growth of fungus.
8	4.14	0.90	0.50	6.6	Moderate growths of fungus and few cysts.	0	0.76	0.81	6.9	
9	0.15	0	0	4.6	Light growth of fungus and few ciliates	0	0	1.91	6.5	
10	2.87	2.80	2.73	5.4	Moderate growths of ciliate and light of fungus.	1.64	2.33	1.86	6.6	Light growth of fungus.
Average	2.37	4.80	[illegible].94	6.0	....	0.76	0 97	1.57	6.8	

TABLE 2.—*Hatching record of T. vulpis embryonated ova in cultures of dycholium-Locke's and Locke's solutions.*

Trial number	Dycholium-Locke's solution					Locke's solution				
	Hours after preparation of culture			pH	Remarks	Hours after preparation of culture			pH	Remarks
	24	48	72			24	48	72		
	Percentage					Percentage				
1	0	-------	0	6.5	Few ciliates	0	-------	0	6.8	Light growth of fungus.
2	0	1.00	-------	7.0	-------	1.00	1.00	-------	6.7	
3	0	0	-------	6.9	-------	0	0	-------	6.8	Few ciliates.
4	0	0	0.86	7.2	Occasional ciliates and light growth of fungus.	0	0	0.85	7.0	Occasional ciliates and limited growth of fungus.
5	8.50	1.00	0.90	6.9	Light growth of fungus	1.70	7.14	1.52	6.8	Few ciliates, light fungus growth; numerous cysts.
6	0	3.00	2.60	7.3	Moderate fungus growth and cysts of ciliates.	1.00	4.70	1.80	7.2	Few ciliates, numerous cysts; light growth of fungus.
7	3.93	1.60	-------	7.0	Light growth of fungus	4.16	0.76	-------	6.9	Light growth of fungus.
8	0.62	0.58	0.78	6.9	Moderate growth of fungus	0	1.11	0.51	6.5	Moderate growth of fungus.
9	1.00	1.00	-------	6.9	Tap water 1 empty shell	1.50	1.00	-------	6.7	Tap water 1 empty shell.
10	2.24	3.25	2.51	6.7	-------	3.13	3.60	2.85	6.6	Light growth of fungus.
Average	1.63	1.27	1.27	6.9	-------	1.25	2.14	1.26	6.9	

13.00, and 7.85 in the order given. To a certain degree, this state of affair appears to coincide with more abundant growths of fungus and ciliate, especially the latter. These figures recorded in Table 1 are much lower than the three highest in the initial series. Conversely, the percentage hatch in the Locke's solution is decidedly higher in the second than in the initial series (loc. cit.). In Table 2, the results between the two, that is the dycholium-Locke's solution on one hand, and the Locke's solution on the other, are essentially the same; the optimum for dycholium-Locke's solution being 8.50 per cent, while for Locke's solution, 7.14 per cent. The latter figure is the highest hatch observed in Locke's solution medium when the three series are considered. As in the first two series so in the third, the pH concentration of the culture does not seem to have any bearing in the rate of hatching of the embryonated ova to any significant degree, contrary to the results observed in ascarid eggs using Tyrode's solution as medium (O'Connor, 1951). Considering the over-all results of the present investigation, the higher rates of hatching are recorded in the bile-Locke's solution. During the investigation, in four instances, hatching in a limited degree has also been observed in tap-water culture (Table 1, trial 7 and Table 2, trial 9).

The earliest hatching was noted one and one-half to two hours after incubation. The knoblike plugs of the egg were detached (Plate 1, fig. 3). The vitalline membrane protruded spasmodically through the openings of the shell (Plate 1, fig. 3 and 4). This was probably due in part to the increased activity of the embryo, the result of the increased temperature of the medium. The embryo then began to push itself through one of the openings by means of a forward and a backward actions (Plate 1, fig. 4). In the embryonated ova, in which the embryo showed no sign of life, even if the plugs were detached no such prolapse of the vitalline membrane was noted (Plate 1, fig. 2). When the embryo was about halfway out of the shell a side-wise movements with occasional coiling or/and doubling actions plus contractions of the segment engaged against the brim of the opening took place (Plate 1, fig. 5). By that time the vitalline membrane was ruptured and receded into the egg shell. When the narrower diameter of the embryo was reached, it just glided smoothly out of the shell (Plate 1, figs. 6 and 7). When the embryo hatched through a break in the shell wall it took an explosivelike exit from the shell, the knoblike plugs

remaining in situ (Plate 1, figs. 8 and 9). Examination of some of the embryos disclosed a pointed process at the anterior tip of the embryo (Plate 1, fig. 10). This observation finds support in the statement of Rubin (1954) who stated that *Trichuris vulpis* possesses a lancet or a mouth spear in all states of development.[3] Such a process may have helped the embryo in hatching.

The ratio of the broken to intact empty shell was approximately 1: 35 in the bile-Locke's solution, 1: 8 in the dycholium-Locke's solution, and 1:4 in the Locke's solution media. As a rule, the following day all embryos were dead. With the addition of dextrose in five per cent concentration to some of the cultures, the life span of the embryos was extended to six days. The embryo measured from 0.29 to 0.32 by 0.01 to 0.015 millimeters with an average of 0.31 by 0.01 millimeters.

SUMMARY

Whipworm embryonated eggs hatched in vitro using isotonic Locke's solution at temperature of 37 to 39° C.

The addition of dog bile to the Locke's solution decidedly increased the rate of hatching, but the addition of dycholium did not significantly affect the rate of hatching.

The pH of the media did not seem to enhance the rate of hatching, while the riched growths of ciliate and fungus in the culture tended to coincide with higher rates of hatching.

The mechanism of hatching of the embryo is described. It occurred in two ways: namely, through one of the poles of the egg shell and through a rent of the shell wall; the former predominated.

REFERENCES

O'CONNOR, G. R. Morphological and environmental studies on the hatching of ascarid eggs in vitro. Jour. Parasit. 37 (1951) 179–182.

RUBIN, ROBERT. Studies on the common whipworm of the dog, Trichuris vulvis. Cornell Vet. 44 (1954) 36–49.

[3] Thanks to Dr. Frank A. Ehrenford, Parasitologist of Pitman-Moore Company Research Farm, Indianapolis 6, Ind., for furnishing the writer the above reference.

ILLUSTRATIONS

[Abbreviations: *a*, anterior portion of the embryo; *dl*, dead embryo; *kp*, knoblike plug; *p*, posterior portion of the embryo; *pp*, pointed process; *r*, rent of the shell; *vm*, vitalline membrane.]

PLATE 1

FIG. 1. Trichuris vulpis embryonated egg.
2. Knoblike plugs detached and vitalline membrane remained in situ with dead embryo.
3. Knoblike plugs detached with vitalline membrane prolapsed.
4. Embryo leaving egg shell but still covered with vitalline membrane.
5. Embryo about half-way out of the shell with rupture of the vitalline membrane.
6. Embryo entirely out of the shell.
7. Empty egg shell with vitalline membrane.
8. Embryo hatched through a rent in the shell wall.
9. Empty broken egg shell.
10. Anterior end of the embryo armed with a pointed process.

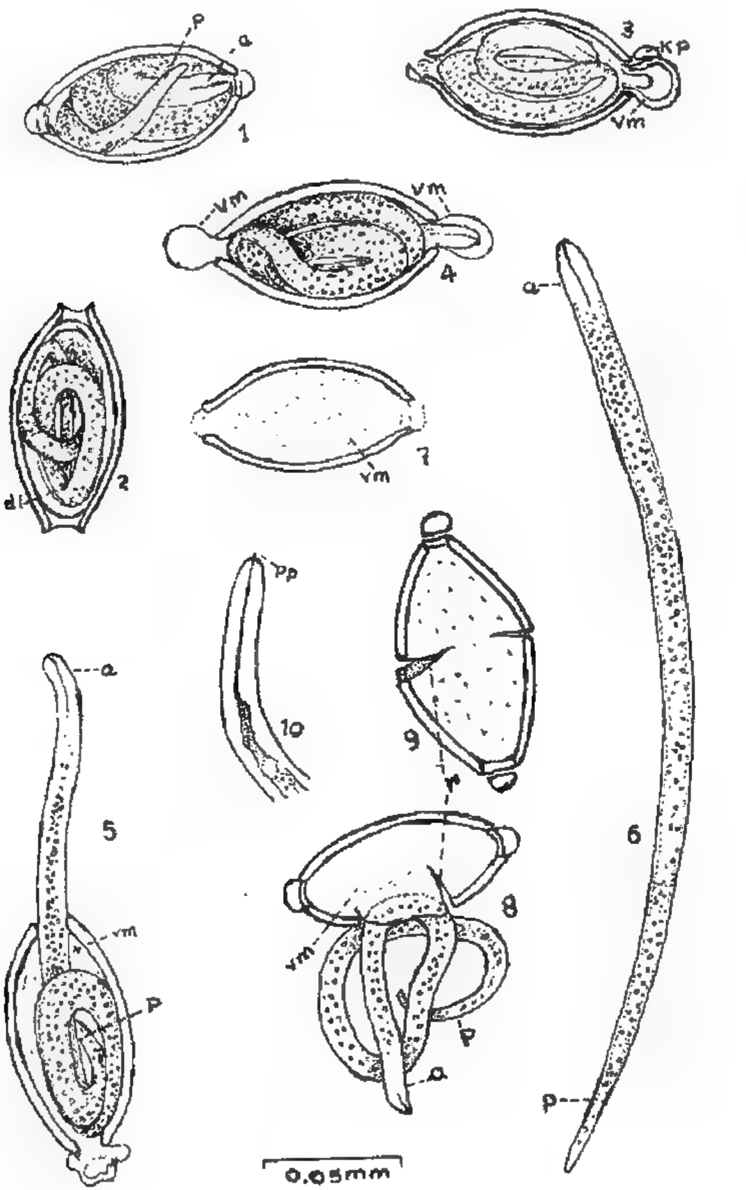

PLATE 1.

THE PHONEMES OF TAGALOG [1]

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Bureau of Public Schools, Manila

This paper is an attempt to present the phonemic system of the Tagalog[2] language.

The dialect represented is the one used in the City of Manila, where the writer was born and raised. The sound system is approximately identical with that taught in the schools.

CONSTRUCTION OF SYLLABLES

Except for borrowed words, there are no consonant clusters within the syllable. Consonant clusters occur only across syllable boundaries and are limited to two consonants.

There are no vowel clusters either within or between syllables.

There are two types of syllables. The first type, CV, consists of any vowel preceded by a single consonant: [*matá*] 'eye', [*kíta*] 'earnings', [*sáma*] 'accompany', [*tá'o*] 'person', [*'áso*] 'dog', [*'isá*] 'one'.

The second type consists of any of the vowels preceded and followed by a consonant: [*saksák*] 'stab,' [*bukbók*] 'termite', [*bagsák*] 'drop', [*laglág*] 'fall'.

One-morpheme words commonly have the following types of structures:

CV . . . [*mo*] 'your', [*ko*] 'my', [*sa*] 'to', [*ni*] 'of'
CVCV . . . [*lála*] 'weave', [*sábi*] 'say', [*butó*] 'seed'

[1] Acknowledgment is hereby made to Dr. Richard S. Pittman of the Summer Institute of Linguistics, to Dr. Cecilio Lopez of the University of the Philippines, and to Dr. Rufino Alejandro of the Institute of National Language for invaluable help received in the writing of the article.

[2] Tagalog is probably the most widely used language of the many spoken in the Philippines, having become widely disseminated throughout the islands since it became the basis of the national language through legislation in 1937. It is spoken mainly in the City of Manila and the provinces of Rizal, Laguna, Cavite, Bulacan, Batangas, Nueva Ecija, Bataan, Mindoro, Marinduque, and Quezon. Within this area, slight differences in vocabulary and intonation exist, reflecting varying occupations and, to some extent, geographical barriers. A considerable percentage of the words in the language have been borrowed from foreign languages. Most of the loanwords are of Spanish, English, Chinese and Sanskrit origin. This introduces a few conflicting phonemic patterns which will be left for later treatment.

CVCVC . . . . [*háwak*] 'hold', [*balik*] 'return', ['*úsap*] 'converse', [*pútik*] 'mud'

CVCCV . . . [*lambí*] 'wottle', [*lampá*] 'feeble', [*gitlá*] 'scare'

CVCCVC . . . [*hagkis*] 'lash', ['*isdá'*] 'fish', [*gitgit*] 'shove'

There are also rare types like CVC . . . ['*am*] 'broth of boiling rice', ['*aŋ*] 'the' [*naŋ*] 'when', CVCCVCV . . . ['*aksayá*] 'waste', and CVCCVCVCVCV . . . [*sampalataya*] 'belief'.

PHONEMES

There are 19 segmental phonemes and 1 suprasegmental phonemic contrast.

Consonants: There are 16 consonant phonemes.

Stops: Voiceless and voiced bilabial: /*p*/*b*/ [*páwa'*] 'all, everything', [*báwa'*] 'each, every'.

Voiceless and voiced alveolar: /*t*/*d*/ [*tagá'*] 'strike with a blade', [*dagá'*] 'mouse'.

Voiceless and voiced velar: /*k*/*g*/ [*kálaŋ*] 'wedge', /*g*/ [*gálaŋ*] 'respect'.

Glottal: /'/ [*bága'*] 'lung'.

Without glottal: [*bága*] 'live charcoal'.

For contrast between /*k*/, /*h*/, and /'/: ['*asín*] 'salt', /*k*/ [*kasí*] 'because of', /*h*/ [*hasík*] 'sow'.

Nasals: Voiced bilabial, alveolar, and velar: /*m*/ [*maŋ*] 'particle anteponed to Christian name of man', /*n*/ [*naŋ*] 'when', /*ŋ*/ [*ŋaŋa'*] 'buyo'.

Voiced alveolar lateral and flap: /*l*/*r*/ [*mulá'*] 'since', [*múra'*] 'young'.

Fricative: Voiceless grooved alveolar: /*s*/ [*silát*] 'slits of bamboo floor'. Laryngeal: /*h*/ [*hilát*] 'stretched opening'.

Semivowels: Voiced high close unrounded /*y*/ [*yári'*] 'make', Voiced high close back rounded /*w*/ [*wári'*] 'reflection'.

Semivowels [*i~y*] and [*u~w*] pattern sometimes as consonants, sometimes as vowels. The determination is made, in each case, by position in the syllable structure. In the canonical patterns of nonsuspect vowel sequences, the vowels are separated by a real or potential glottal stop as in [*toto'ó*], [*ma'a'ári'*]. In cases of vowel sequences involving one semivowel and *a*, or two semivowels, [*kamai*] or [*baiad*] and [*baual*] or [*baliu*] there is no potential glottal stop. Since some of the semivowels in these cases are also non-syllabic (i.e., do not have a stress potential) and since they fit the CVC patterns, but not any non-suspect VV patterns, they are written as y and w: /*kamáy*/, /*báyad*/, /*báwal*/, /*balíw*/ instead *kamai, baiad, baual, baliu.*

There are instances when the combination /*ay*/ is equivalent to [*e*], particularly in colloquial[3] speech, e.g. [*mero'ón*] or [*méron*] instead of [*mayro'ón*]; [*ke*] instead of [*kay*]; [*kelan*] instead of [*káylan*]. This, however, does not affect the phonemic analysis.

DISTRIBUTION

All consonants except /*h*/ and /*r*/ are found in initial and final position in syllables. /*h*/ and /*r*/ occur only syllable-initial. *p*—[*puwáŋ*] 'space', ['*ísip*] 'mind'; *t*—[*takbó*] 'run'. [*dágat*] 'sea'; *k*,—[*káhoy*] 'wood', ['anák] 'offspring'; *b*—*b*—[*báboy*] 'pork'. ['*álab*] 'flame'; *d*—[*dúnoŋ*] 'intelligence', [*tadyáŋ*] 'rib'; *g*—[*agád*] 'quick', [*súnog*] 'burnt'; *m*—[*mas-dán*] 'look', [*sambá*] 'worship'; *n*—[*panayám*] 'conference', ['*ulán*] 'rain', *n*—[*ŋayón*] 'now'; [*sáboŋ*] '*cockfight*'; l—[*lamók*] 'mosquito'; [*makapál*] 'thick'; *s*—[*sísiw*] 'chick', [*pá-wis*] 'perspiration,; ' [*áwa'*] 'pity', [*hába'*] 'length'; *y*—[*yáta'*] 'perhaps', [*atáy*] 'liver'; *v*—[*walá'*] 'none', ['*alíw*] 'consolation'.

/*h*/ and /*r*/ in syllable initial position only: /*h*/ [*halík*] 'kiss'; [*báhay*] 'house'; /*r*/ [*laró'*] 'play', [*súrot*] 'bed-bug'.

Apparent exceptions ['oh] and ['ah] in the pronunciation of some speakers, occur in exclamations only.

Syllable-final /r/ occurs only in loan words as in [*lugár*] 'place' (Spanish) which is often pronounced and spelled *lugál*.

CONTRAST OF CONSONANTAL PHONEMES

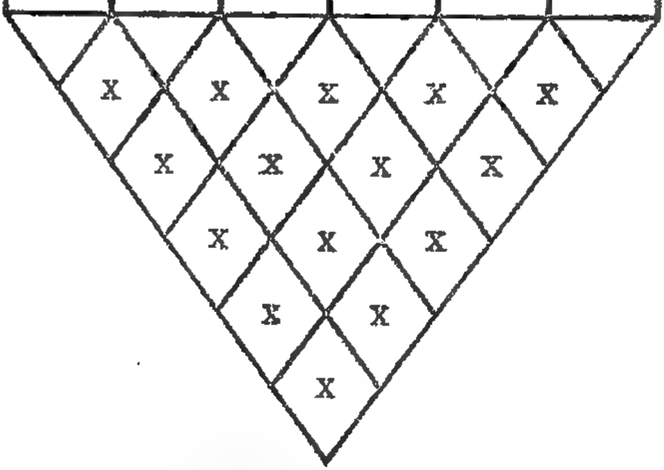
Because of several well-known consonant alternations in Proto-Malayo-Polynesian, the following consonants must be specially checked for distributional contrasts: /r/,/d/,/g/,/h/,/l/,/y/. By demonstrating contrast in identical and analogous environments, their identity as distinct phonemes can be established.

The following chart illustrates the contrasts between these consonants. The symbols on the left of the chart indicate the position of the phonemes in the word structure, the corresponding examples of which are given at the bottom of the chart. # indicates world boundary, ( ) stands for the position under consideration, V—vowel, C—consonant, O—occurrence, . indi-

[3] Variation arises from regional peculiarities and intonation. In some provinces /*ay*/ is given an *i* sound, e.g. [*mi*] instead of [*me*] or [*may*]; [*ki Marya*] instead of [*ke Marya*] or [*kay Marya*].

cates syllable division, and X indicates the presence of contrast between the two phonemes whose columns converge at the diamond occupied by that X.

Position	r	l	d	g	h	y
#( )V–	0	0	0	0	0	0
–V( )V–	0	0	0	0	0	0
–V( ).C		0	0	0		0
–C.( )V–		0	0	0	0	0
–CV( )#		0	0	0		0



EXAMPLES

( ) V—[*rahúyo'*] 'charm', [*labás*] 'out', [*dahás*] "force', [*gamót*] 'medicine', [*hába'*] 'length', [*yáman*] '*wealth*'.

—V( ) V—['*áraw*] 'sun', ['*alam*] 'know', [*madalas*] 'often', [*úga*] 'earliness', ['*ahas*] 'snake', [*láyas*] 'leave'.

-V ( ).C—[*'alpás*] 'get loose', [*ladlúd*] 'unfurl', [*'agwát*] 'distance', [*laylay*] 'hanging'.
-C.( ) V—[*biglá'*] 'suddenly' [*tigdás*] 'measles', [*mayga*] 'mango'; [*tighâw*] 'alleviation', [*bakyá'*] 'wooden shoes'.
-CV ( ) # [*púgal*] 'tie', [*pálad*] 'palm' [*bálag*] 'arbor', [*pálay*] 'rice plant'

VOWELS

There are 3 vowel phonemes: /*i*/, /*a*/, /*u*/.

/i/ has two submembers [i] and [e]. [i] high front close rounded alternates with [e] mid front close unrounded vocoid in word-final position—[*sábi~sabé*] 'say', [*babá'i~babá'e*] 'woman' [*gabí~gabé*]'night'. Final [e] becomes [i] before a following suffix-[*babá'e*] 'woman'>*kababa'íhan* 'group of women', [*'úbe*] 'yam'>[*'ubihán*] 'yam garden'. [e] does not occur word initial or medial except in words borrowed from Spanish, English, and Chinese: [*eskuwela*] (Sp.) 'school', [*net*] (Eng.) 'net', [*pénoy*] (Ch.) 'duck's egg with broken yolk'. These are pronounced with an [i] by illiterate monolinguals, e.g., [*iskuwíla*] [*nit*] [*pínoy*].

/u/ has two submembers: [u] and [o]. [u] alternates with [o] in word-final syllables. [*súso~súsu*] 'breast'; [*sapúl~sapól*] 'since. When [u] and [o] occur together in a word, [u] always occurs first: [*bu'ód*] 'summary', [*bu'o'*] 'whole'. Word final [o] becomes [u] when followed by a suffix; it also becomes [u] when the word is reduplicated: [*dúlo*] 'end', [*dúluy–dúlo*] the very end', [*takbó*] 'run', [*takbuhin*] 'to run' [*waló*] 'eight', [*walú-walo*] 'by eights', [*lugót*] 'snapped', [*lagút-lagot*] 'snapped into many pieces'.

SUPRASEGMENTAL PHONEMES

Tagalog has one suprasegmental phonemic contrast: stress. Words may differ in meaning depending on the stress placement: [*'áso*] 'dog', [*'asó*] 'smoke', [*páko'*] 'nail', [*pakó'*] 'fern', [*yári*] 'happening', [*yarí*] 'this', [*maká'in*] 'to be able to eat', [*máka'in*] 'to eat accidentally'.

The presence of length in Tagalog has been suggested by some students of the language, but the writer has not yet thoroughly investigated this possibility. However, she cannot locate any minimal pair which has a long/short contrast.

The writer believes stress and length are correlated in Tagalog and she prefers to consider that stress conditions length rather than vice versa. [*gumá:gawá'*] /gumágawá/ 'doing', [*lá:labindalawá*] /*lálabindalawá*/ 'only 12'.

ORTHOGRAPHY OF TAGALOG

There are two kinds of orthography used at present: one is used in literature for the general public and the other is used in textbooks, readers, and grammar books for elementary and secondary schools. In the first type stress and glottal stop are left unmarked. In the second, stress is indicated by an acute accent, except penultimate stress, which is left unmarked. Word-final glottal stop is indicated by a grave accent over the preceding vowel. A combination of final syllable stress and word-final glottal stop is written as a circumflex accent over the final vowel: */lúha'/ luhà* 'tear'; */samá'/ samâ* 'bad'.

In all kinds of writing, however, penultimate stress is left unmarked, and when the second consonant of a consonant cluster is a glottal stop, it is indicated by a hyppen. This type of cluster has been observed only between a prefix and a wordbase: *pag-ibig* 'love', *mang-away* 'to quarrel'.

The submembers of /i/ which are [i] and [e], and the submembers of /u/, [u] and [o] are written with the symbols here indicated. */ŋ/* is written as *ng*. Glottal stop in word-initial and intervocalic position is not indicated: *aliw* for */'aliw/* 'amuse', *maásim* for */ma'asim/* 'sour'. In –C.( )—position it is written with a hyphen, */mag'aral/ mag-aral.*

The following is the contemporary alphabet used in Tagalog:

a, b, k, d, e. g, h, i, l, m, n, ng, o, p, r, s, t, u, w, y.

A BRIEF ILLUSTRATIVE TEXT (TALE BY ROSENDO G. ALVAREZ)

Ang Usa at ang Leon (The Deer and the Lion)

1.[4] *Samantalang naglalakad sa kagubatan ang isang usa at naghahanap ng pagkain, ito'y nakaki'a ng isang sanggol na leon na lumuluhang nakayapos sa inang patay na.* While walking in forest the one deer and looking the food this (lig.) saw the one baby (lig.) lion (lig.) crying embracing to mother dead already. 2. "*Bakit totoy, ano ang nagyari sa nanay mo?*" "Why little lion what the happened to mother yours?" 3. "*Binaril po ng mga mangangaso. Mabuti po at nakapagtago ako,*" *ang umiiyak na tugon ng ulilang leon.* "Was shot sir/madam by hunter. Good sir/madam and was-able-to-hide I," the crying (lig.) answer of orphan lion. 4. "*Huwag kang malungkot,*" *ang wika ng usa.* "*Sumama ka sa akin at ituturing kitang anak.*" "Don't you be unhappy," the saying of deer. "Come you with me and will treat I—you child." 5. *Kayo po ang bahala para na nga ninyong habag,*" *sagot ng leon* "You sir/madam the one-to-take-charge as (lig.) (particle) your pity," answered the lion. 6. *Oo, isasama kita,*" *at maingat na dinala ng usa ang leon sa kanyang tinatahanan.* "Yes will-take-with me-you" the carefully (lig.) carried by deer the lion to his where living.

[4] The orthography used is the one used in general literature, not the one used in the National Language schooltexts.

FREE TRANSLATION OF THE TEXT

1. While a deer was walking in the forest, looking for food, it saw a baby lion crying and embracing its dead mother. 2. "Why little lion, what happened to your mother?" 3. "She was shot by the hunters. It was good that I was able to hide," answered the crying orphaned lion. 4. "Don't you be unhappy," the deer said. "Come with me and I will treat you as my child." 5. "I trust it to you sir/madam, for pity's sake," answered the lion. 6. "Yes, I will take you with me," and the deer carefully carried the lion to where he was living.

THE SPECIES OF PLECTOCHORUS (HYMENOPTERA, ICHNEUMONIDÆ)[1]

By HENRY TOWNES[2]
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ONE TEXT FIGURE

Plectochorus is a small genus of mesochorine ichneumonids, known to date only from the Orient. The need to describe a new species of the genus from Micronesia in connection with a paper on the ichneumonids of that area prompts a revision of all of the species at hand, one from Japan, two from the Philippines, and one from the Palau Islands.

The location of the specimens on which this study is based is given in parenthesis after the data on each of the specimens. The institutional collections containing the material are indicated by the name of the city in which the institution is located and private collections, by the name of the owner.

Genus PLECTOCHORUS Uchida

Plectochorus UCHIDA, Insecta Matsumurana 7 (1933) 163. One species. Type: *Mesochorus iwatensis* Uchida, 1928. Original designation.

This genus is close to *Stictopisthus*, with which it agrees in the following characters: Nervellus not broken, the discoidella completely absent; first tergite not laterally carinate beyond the spiracle; upper end of prepectal carina reaching the swollen marginal rim of the mesopleurum; transverse carina on face below antennæ not dipped medially; nervulus beyond the basal vein. Females of the present genus differ from *Stictopisthus* in having the ovipositor sheath only about four times as long as wide and the apex of the propodeum reaching to or beyond the apical 0.7 of the hind coxa. In *Stictopisthus* the ovipositor sheath is about twelve times as long as wide and the apex of the propodeum does not reach the middle of the hind coxa. Males of the two groups are not separable, and it may be that *Plectochorus* would be better treated as a subgenus. For the present, however, its generic status is retained.

[1] Contribution from the Entomology Department, North Carolina Agricultural Experiment Station. Published with approval of the Director as Paper No. 657 of the Journal Series.

[2] Research Professor of Entomology.

Figure 1 shows the habitus of the genus.

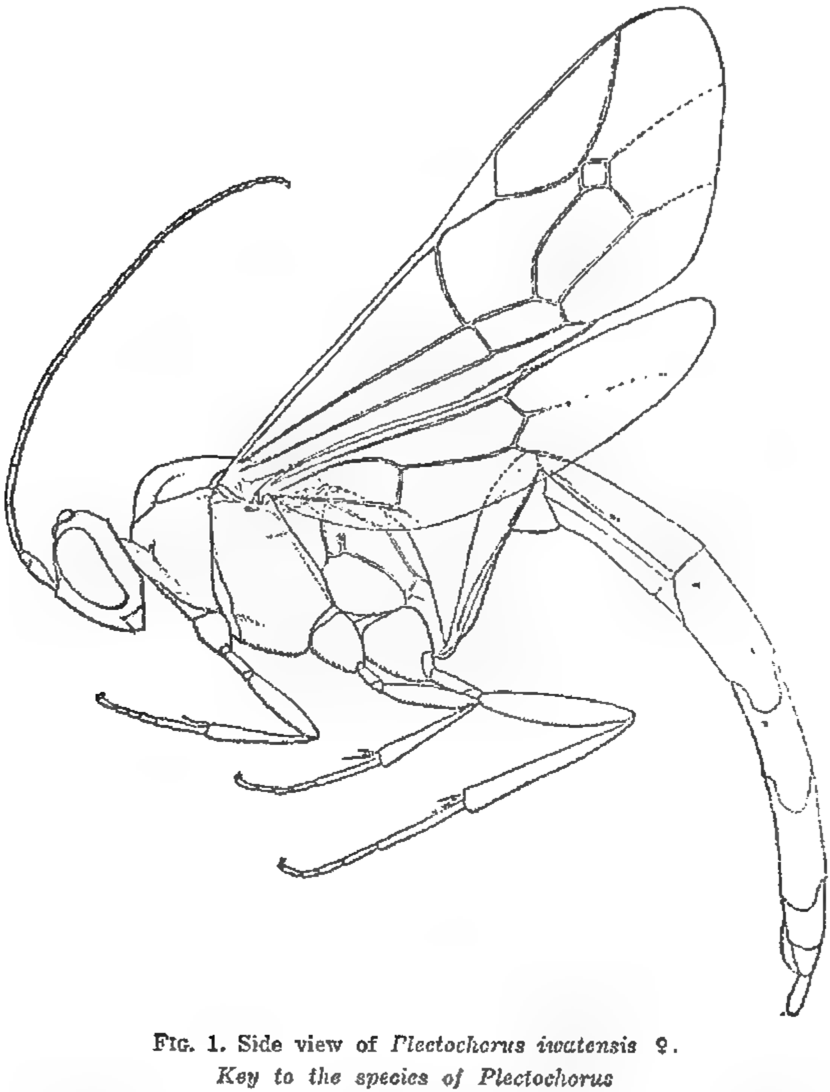

FIG. 1. Side view of *Plectochorus iwatensis* ♀.

Key to the species of Plectochorus

1. Areola separated from petiolar area; lateral lobes of mesoscutum pale 2
   Areola confluent with petiolar area; lateral lobes of mesoscutum blackish 3
2. Hind tibia pale with the apex infuscate; propodeum pale with the basal half mostly fuscous; thoracic punctures a little denser. 1. *iwatensis* Uchida
   Hind tibia pale with the apex faintly darker; propodeum uniformly pale; thoracic punctures a little sparser .... 2. *debilis* sp. nov.
3. Second lateral area of propodeum about 1.7 as long as wide; mesopleurum and metapleurum fulvous .... 3. *palauensis* sp. nov.
   Second lateral area of propodeum about 3.0 as long as wide; mesopleurum and metapleurum blackish .... 4. *ophioides* sp. nov.

1. **PLECTOCHORUS IWATENSIS** Uchida.

Mesochorus iwatensis UCHIDA, Jour. Fac. Agr. Hokkaido Univ. 21 (1928) 262. Type: ♀, Iwate, Honshu (Sapporo).

Plectochorus iwatensis UCHIDA, Insecta Matsumurana 7 (1933) 163–164. Generic position.

Plectochorus iwatensis UCHIDA, Insecta Matsumurana 8 (1933) 53. Honshu (Iwate, Kanagawa, and Shizuoka). Parasite of *Grapholitha molesta.*

Plectochorus iwatensis ALLEN, HOLLOWAY, and HAEUSSLER, Cir. U. S. Dept. Agr. 561 (1940) 58. Reared in small numbers from *Grapholitha molesta* collected in Japan.

Plectochorus iwatensis HAEUSSLER, Tech. Bull. U. S. Dept. Agr. 728 (1940) 24–25. Reared in Japan as a solitary primary parasite of immature larvæ of *Grapholitha molesta.*

Male.—Similar to the female in structure and color except that the propodeum and the abdomen are shorter. The apex of the propodeum is at the basal 0.2 of the hind coxa; and the first and second abdominal tergites are each about 3.0 as long as wide.

Female.—Fore wing about 3.2 mm long; punctures on lower half of mesopleurum rather coarse with interspaces averaging about 1.5 their diameter; second lateral area of propodeum about 2.0 as long as wide; apex of propodeum even with the apex of the hind coxa; first tergite about 4.2 as long as wide; second tergite about 4.0 as long as wide.

Fulvous. Flagellum brownish apically; wings hyaline, the veins fulvous; propodeum piceous in an area covering approximately its first and second lateral areas, basal area, and areola; apex of hind tibia sharply infuscate; first abdominal tergite piceous subapically, fading out basad, its apical 0.2 buff; second tergite piceous basally and along the side to beyond its middle; ovipositor sheath light brown. In some specimens the dark markings are more extensive, with the lateral lobes of the mesoscutum marked with brown, the propodeum more extensively piceous, the first tergite mostly piceous, and the second tergite mostly piceous with a submedian elongate oval pale area.

Specimens.—2♂, 1♀, reared from *Grapholitha molesta,* Haijima, Niigata-ken, Japan, July, 1935 (Washington). 3♀, reared from *Grapholitha molesta,* Hara, Shizuoka-ken, Japan, July, 1936 (Washington). ♀, reared from *Grapholitha molesta,* Kamihobara, Fukushima-ken, Japan, August, 1935 (Washington). ♀, reared from *Grapholitha molesta,* Motosumiyoshi, Kanagawa,

Japan, July 27, 1933 (Washington). ♂, reared from *Grapholitha molesta*, Seiromura, Niigata-ken, Japan (Washington). 2♂, 3♀, reared from *Grapholitha molesta*, Japan, 1935 (Washington). 2♂, 2♀, Japan, G. J. Haeussler (Townes). ♀ (type), Iwate, Honshu (Sapporo).

This species is widely distributed in Japan on the island of Honshu, where it has been reared repeatedly, though in small numbers, as an apparently primary parasite of larvæ of *Grapholitha molesta* (Olethreutidæ).

2. PLECTOCHORUS DEBILIS sp. nov.

Male.—Unknown.

Female.—Fore wing 2.5 mm long; interspaces of punctures on lower half of mesopleurum averaging about 1.7 their diameter; apex of propodeum even with apex of hind coxa; second lateral area of propodeum about 2.1 as long as wide; areola separated from propodeal area by a distinct carina; second tergite about 3.6 as long as wide.

Fulvous. Flagellum brownish apically; wings hyaline, the veins pale fulvous; hind tibia pale fulvous, its apex faintly darker; base of second tergite dark brown.

Type.—♀, Tagaytay Ridge at 800 m, Cavite Province, Philippines, November 9, 1952, Townes family (Townes).

3. PLECTOCHORUS PALAUENSIS sp. nov.

Male.—Unknown.

Female.—Fore wing 2.8 mm long; punctures on lower half of mesopleurum rather fine, with interspaces averaging about 2.2 their diameter; propodeum extending to the apical 0.8 of the hind coxa; second lateral area of propodeum 1.7 as long as wide areola not separated from petiolar area by a distinct carina; second tergite 3.3 as long as wide.

Ferruginous. Flagellum brownish except basally; ocellar area, occiput, lateral 0.3 of mesoscutum propodeum, upper part of dorsal division of metapleurum, first abdominal segment except for a pale area dorsally at the apex, and second abdominal tergite except for pale areas centrally and apically piceous or fuscous; third abdominal tergite mostly piceous; fourth and following segments tinged with brown; ovipositor sheath piceous; wings hyaline, the veins light brown; hind tibia lightly infuscate at the base and sharply infuscate at the apex.

Type.—♀, Koror, Palau Islands, June, 1953, J. W. Beardsley (Honolulu).

4. PLECTOCHORUS OPHIOIDES sp. nov.

Male.—Unknown.

Female.—Fore wing about 3.7 mm long; punctures on lower half of mesopleurum coarse, the interspaces averaging about 1.2 their diameter; apex of propodeum surpassing apex of hind coxa by 0.15 the length of the hind coxa; second lateral area of propodeum about 3.0 as long as wide; areola confluent with the petiolar area; second tergite about 3.6 as long as wide.

Piceous. Head light brown; occiput and most of vertex dark brown; central part of frons brownish; face centrally a little darker than laterally; upper and lower parts of pronotum, area along notaulus, scutellum, speculum, and ventral part of abdomen light brown; abdomen medium brown beyond the second segment; wings hyaline, the veins brown; legs fulvous, the hind tibia infuscate basally and apically.

Type.—♀, mossy oak forest at 2,300 m, Mt. Data, Mountain Province, Philippines, December 30, 1952, H., M., and D. Townes (Townes).

Paratype.—♀, collected same place as the type but on January 1, 1953 (Townes).

63062——6

NEW RICE HYBRIDS AND THEIR COMMERCIAL POSSIBILITIES [1]

By F. B. SERRANO [2]
Bureau of Plant Industry, Manila

SEVEN PLATES

According to Torres, J. P.(15) rice improvement work in the Philippines on a scientific basis was started as early as 1902 when some rice seeds were imported from Japan. This was followed by the introduction of the Carolina Golden variety from the United States in 1905. Other introductions followed in succeeding years making a total of about 400 varieties introduced from countries all over the world, including Australia, Borneo, Burma, China, Egypt, Federated Malay States, Formosa, French Indo-China, India, Japan, Persia, Siam, Spain, the United States and Thailand. Among such varieties may be mentioned Ramai, Ketan Koetoek and Malangkit Sungsong from French Indo-China; Khao Bai Sri (locally known as 1236) from Thailand; Seraup Besar 15 and Seraup Kechil 36 from Federated Malay states; Taichu 65 from Formosa and Fortuna from the United States. Of late, new promising varie-

[1] Part I of a scientific treatise "Improvement of the Philippine Rice Industry on a Permanent Basis."

[2] The author wishes to express his gratitude for the kind interest shown and the help extended *(1)* by Dr. Marcos Alicante, Chief, Soil Survey Division (now Director, Soil Conservation Bureau), Department of Agriculture and Natural Resources under which this project was started, and *(2)* by Mr. Jose G. Sanvictores, General Manager, Buenavista Estate, San Ildefonso, Bulacan, at whose instance this work was undertaken before the outbreak of the last World War. He also wishes to acknowledge the valuable help and assistance rendered by his former technical staff composed of Messrs. Macario Palo, Ambrosio Madamba, Crispin Hernandez, Ramon Samaniego, Arcadio Querijero, Isidoro Romero, Saturnino Posadas and, later, by Messrs. Esteban Cada, Pedro Castillo and Cipriano Ancheta. The author is also grateful to Mr. Victorino Borja, formerly of the Bureau of Plant Industry, for furnishing many of the standard varieties used in the comparative variety test and to the Institute of Science and Technology and Institute of Nutrition for the determination of the nutritive values of the rice samples included in these studies, and to Director Eduardo Quisumbing of the National Museum for reading the manuscript and giving useful suggestions thereon.

ties like Peta, Intan, Tjahaja, Tjeremas, etc. have been introduced from Indonesia.

The Philippine Government embarked also upon pure-line selection as early as 1909 when Jacobson, H. O.(4) used the head-to-the-row test method. This effort was rewarded by the isolation of Señora II, which was later re-named Apostol in honor of then Under-Secretary Silverio Apostol. Later, Borja, V., Manio, R. V., Cabanos, J., and Torres, J. P. pursued at same technique and isolated Sipot, Guinangang str. 1 and Kinastila IV.

To further increase yield-gains from seed introduction and pure-line selection, Torres, J. P. started artificial hybridization in 1920. For some reasons, however, the work remained unsuccessful until 1928 when Reyes, G. M., Torres, J. P., and Unite, J. O.(11) artificially crossed Ramai and Inadhica, producing in 1931 the present popularly known Raminad str. 3 or Quezon rice, named in honor of then President Manuel L. Quezon, which proved to be a high yielder and resistant to common diseases.

The adoption of scientific techniques involving variety introduction, pure-line selection and artificial hybridization, may be thought, as in truth some think, to be the ultimate in rice improvement work in the Philippines, which would ensure the country's self-sufficiency in rice and the economic security of those dependent on the industry. Unfortunately, this is far from being true. The Philippines is still importing rice as shown by Ortigas Jr., F.(8) her rice deficiency being placed in 1951 at 1,962,500 cavans and her total importation at 1,948,631 cavans.

A similar review of rice improvement work done in other countries in the past, brings to light some interesting facts which should serve as eye-openers to both political and economic leaders of the Philippines. In such rice-producing countries as Japan, India, China, and others, research institutions, experiment stations and other kinds of similar offices exclusively devoted to rice research are established and maintained with sufficient appropriations and manned by adequate and competent technical staff. In such countries they form important adjuncts of their governments devoted to the enhancement of the rice industry. Such facilities and instrumentalities, except for a couple of non-too-well equipped experiment stations, have been almost conspicuously absent in the Philippines.

The wide divergence in the number of workers engaged in the improvement of rice varieties in different countries is also considerable. According to the latest list of the world plant breeders issued in December, 1952, by the Food and Agriculture Organization(16) Japan has a total of 94; India, 18; Italy, 7; Portugal, 6; Egypt, 5; Pakistan, 5; and the Philippines, 5. Of the 5 for the Philippines only 3 are doing actual breeding work—one in the College of Agriculture in Los Baños and two in the Bureau of Plant Industry.

Local indifference to these fundamental needs of the rice industry is also reflected in the measly sum of ₱30,000 appropriated annually for agricultural research in general, an indifference which has been the greatest handicap to rice improvement work in the Philippines. This probably explains why our total progress in local rice improvement work has been slow compared to that of other countries especially Japan where similar work has been undertaken, according to Sunaga,(13) first by Kato who started artificial hybridization in 1906, followed by Terao, who made use of pure-line selection in 1910.

According to Ramiah, K.(9) rice breeding was started first in Bengal and later in Madras over three decades ago, and is now carried on in 48 stations distributed in all the rice growing Indian states. This does not include the work of the Central Rice Institute at Cuttack. Their breeding program aims at increased yield, disease resistance, earliness, better physiological characters and others.

The importance of research studies and the need of providing adequate funds therefore, may be appreciated by knowing how the Philippines stands with other countries in rice production. In average yield, the Philippines occupies the 14th position with only 27 cavans per hectare against 141 of Spain, 120 of Italy, 91 of Japan, 85 of Egypt, 57 of China, 56 of the United States, and 54 of Korea. This is despite the fact that, in the light of present-day knowledge of the optimum cultural requirements for rice, Philippine climatic and soil conditions compare favorably with those of other countries. While from 1909 to 1948, a span of 39 years, Japan and Korea increased their average yield per hectare from 69.7 to 91.6 and 36.1 to 51.1 cavans, respectively, the Philippines increased hers from 16.6 to 26.9 cavans showing a total increase of 21.9 cavans for Japan, 15 cavans for Korea, and 9.3 cavans for the Philippines, or an

average annual increase of 0.56 cavan for Japan, 0.38 cavan for Korea, and 0.24 for the Philippines, in a ratio of 2.3:1.6:1.

According to Matsuo, I. as reported by Sunaga, S.(13) 70 per cent of the total rice land in Japan was planted in 1942 to pedigreed seeds of which 46 per cent was to hybrid seeds, and 24 per cent to pureline seeds; the remaining 30 per cent was planted to old-type seeds. On the other hand, Borja, V. and Torres, J. P.(1) reported that out of 1,888,794 hectares planted to rice in the Philippines in 1949, only 665,950 hectares or 35 per cent were covered by standard or improved seeds, the remaining 1,222,844 hectares or 65 per cent being planted to non-standard varieties. In other words, from 1909 to 1942 or in the span of 33 years Japan was able to plant 70 per cent of its total rice area to pedigreed seeds, while it took the Philippines from 1909 to 1949 or 40 years to plant only 35 per cent of its total area to selected or standard varieties. Japan's rate in putting its rice land to pedigreed seeds is therefore 2.3 greater than the Philippines', which doubtless accounts in a great measure for the big difference in the present average hectare yield between the two countries.

Moreover, Terao,(14) in his statistical studies on the effects of the breeding techniques on rice yields in Japan, has shown that 9 per cent of the increase was attributable to pure-line selection of 261 varieties and 16.2 per cent to the hybrid seeds of 12 varieties. This means that every variety of the pedigreed seeds used, granting that all have the same producing power within the class, has increased the average annual yield by 0.034 per cent in the pure-line seed group and 1.35 per cent in the hybrid seed group. In the light of the foregoing facts it is quite safe to state that hybridization is roughly 40 times more potent than pure-line selection as a means of improving and increasing rice yield. This explains why in the span of 40 years Japan has progressed 2.3 times faster than the Philippines in improving its average hectare yield. While the Philippines kept busy with seed introduction and pure-line selection which covered a period of about 26 years, Japan went straight ahead hybridizing and producing high yielding varieties to replace the old types.

The potency and validity of increasing and improving rice yields through the use of better varieties and seeds as shown by Japan encouraged the author to adopt the same course of hybridization and selection which led him to the creation of the new varieties described in this paper.

PRE-WAR INVESTIGATIONS

To determine the causes of rice failure particularly in the municipalities of San Ildefonso and San Rafael, Bulacan Province, an extensive survey was undertaken in November, 1939, by the writer at the instance of the then General Manager of the Buenavista Estate, Rural Progress Administration. Extended to cover practically all the rice-producing provinces of Luzon during the two crop-years from 1940 to the outbreak of World War II in 1941, the investigation showed that the cause of the rice crop failure in Bulacan, particularly in Buenavista Estate, were: (*1*) the use of inferior varieties and seeds; (*2*) the prevalence of diseases and pests particularly stunt and stemborers; (*3*) poor soil condition brought about by erosion and depletion coupled by the lack of proper soil treatment; (*4*) inadequate irrigation facilities, and (*5*) nonobservance of improved scientific methods of culture in general. These findings were confirmed by the result obtained from the comparative variety tests conducted during the period of the investigation

TABLE 1.—*Yield in cavans per hectare of different rice varieties.*[1]

Index No.	Variety	I	II	III	IV	V	Total	Average
1	Apostol	45.0	34.4	39.2	42.0	40.5	2,011	40.22
2	Canoni	25.4	18.0	27.1	20.2	19.3	1,100	22.00
3	Dinorado	30.3	35.0	32.2	40.0	39.0	1,765	35.30
4	Elon-elon	56.2	61.7	45.0	49.9	52.8	2,658	53.12
5	Fortuna	48.0	49.6	38.8	47.0	46.4	2,300	46.00
6	Guinangang	35.1	38.0	32.8	36.6	38.0	1,805	36.10
7	Kasungsong	46.4	55.6	49.0	51.1	50.0	2,521	50.42
8	Ketan Kootock	60.5	49.9	52.0	50.5	58.7	2,716	54.32
9	Khao Bai Sri	44.0	50.5	36.0	46.6	45.0	2,115	42.30
10	Kinawayan	29.7	34.0	38.5	30.3	28.0	1,605	32.10
11	Macan I	31.1	42.6	46.7	33.0	37.7	1,971	39.42
12	Macan Baret	28.0	26.6	30.3	26.5	29.9	1,413	28.26
13	Macan Bino	26.8	30.3	31.8	22.0	29.6	1,405	28.10
14	Macan Cumpol	29.0	26.6	32.0	25.4	23.5	1,445	28.90
15	Macan San Miguel	32.2	35.0	31.7	30.8	29.9	1,596	31.92
16	Macan Santa Rosa	31.1	38.8	27.0	29.5	35.0	1,614	32.28
17	Macan Senora	37.0	32.6	35.5	41.0	30.3	1,759	35.70
18	Macan Tago	25.7	30.8	23.3	29.4	26.6	1,358	27.16
19	Magsanaya	39.5	34.0	42.8	38.1	42.3	1,967	39.34
20	Malagkit Sungsong	40.0	32.2	36.9	44.0	45.5	1,986	39.72
21	Mancasar	31.3	30.6	37.7	30.8	38.0	1,689	33.78
22	Milagrosa	48.0	46.8	44.0	52.0	47.4	2,382	47.64
23	Mimis	35.5	30.4	41.0	30.3	34.4	1,716	34.32
24	Pinili	37.6	31.9	36.8	30.4	40.0	1,767	35.34
25	Ramelon 2	49.0	42.0	46.8	37.5	51.0	2,263	45.26
26	Raminad Str. 3	61.6	59.1	50 0	57.5	60.8	2,780	55.60
27	Seraup Besar 15	59.0	66.4	50.5	59.0	61.7	2,966	59.32
28	Seraup Kechil 36	50.3	59.0	50.2	53.7	59.0	2,722	54.44
29	Seraup Kechil 148	47.7	52 0	53.5	50.5	55.0	2,602	52 04
30	Sipot	29.0	32.2	30.3	25.3	30.2	1,468	29 36
31	Taichu 65	28.1	23.8	31.4	30.8	22.0	1,361	27.22
32	Wagwag	48.8	50.0	45.4	51.0	46.6	2,418	48.36
	TOTAL	1,257.4	1,278.8	1,247.7	1,251.1	1,289.1	63,241	1,265.38
	Average	39.29	39.96	38.99	39.09	40.28	--------	39.54

[1] All varieties seriously affected by stunt produced less from 30 cavans per hectare. This disease was serious particularly in 1940.

with and without the use of fertilizers on 32 leading commercial varieties planted in plots of about 50 sq. m. each and replicated five times, and from the series of inoculation experiments made both in the green house and out in the fields which showed (*a*) that the prevalent malady of rice then as now is the stunt disease (known as "Accep na pula" by the Tagalogs, "Kadang-kadang" by the Bicolanos, and "Tungro" by the Pampangos) caused by a virus transmitted by the rice leafhopper, *Nephotettix bipunctatus cincticeps* Uhler, and (*b*) that the worst rice pest is "Tamasok" or "Uban" caused by the stemborers mostly *Schoenobius incertullus* Walker and *Chilo simplex* Butler.

THE NATURAL HYBRIDS

Ordinarily, rice plants are self-pollinated. Under some special conditions, however, cross-pollination takes place especially between individuals with complete sexual affinity. For instance, if two varieties with complete sexual affinity are planted close together and flowering occurs simultaneously, or at practically the same time, natural crossing occurs and a natural hybrid is produced. On the other hand, in the light of the results obtained by Mizushima(7) from his studies on sexual affinities among rice varieties of different types, fertile progenies can least be expected from cross-pollination between *japonica* type-a group and *indica* type-j group. Apparently, neither of the three varieties involved in this study belongs to either group types mentioned by Mizushima, inasmuch as natural cross-pollination took place successfully between Buenavista and Ketan Koetoek, producing the F_0 hybrid seeds of Buenketan, and between Milagrosa and Ketan Koetoek, producing the F_0 hybrid seeds of Milketan. From these were produced the F_1 progenies of both Buenketan and Milketan, which were spotted out and isolated in the second planting.

In the first planting of the comparative variety tests of Buenavista, Milagrosa, and Ketan Koetoek the plots were laid out adjoining each other. This and the fact that they flowered at practically the same time made possible the identification of these natural hybrids with their respective parentage. Other varieties planted similarly at random flowered either too early or too late to permit chance-crossing among themselves. Moreover, the characteristic features manifested by the F_1 progenies were definitely of Buenketan-Ketan Koetoek and Milagrosa-Ketan Koetoek blendings. This was clearly manifested in the progenies of the succeeding F_2, F_3, F_4, etc. generations where

segregants were of the greatest number, with some showing sterility of different degrees and others with owness although neither parent plant is owned, as well as in the final selections of the stabilized strains. Thus, the new hybrids, Buenketan, a natural crossing between Buenavista and Ketan Koetoek, and Milketan, a natural crossing between Milagrosa and Ketan Koetoek have been produced.

POSTWAR INVESTIGATIONS

The postwar investigations are essentially the continuation of prewar investigations which involved both the pedigree and bulked progeny method of selection and stabilization of the two natural hybrids and, later, the creation of new and better hybrids through artificial hybridization and selection. As discussed below, both Buenketan and Milketan possess many good qualities which deserve the approval of both the producers and the millers, as well as the consumers. It is felt, however, that one or two of their weak points, such as too tight grain attachment, slight susceptibility to drought and especially to stemborers, in the case of the Milketan, could be greatly improved if not completely eliminated by further selection and hybridization.

The following artificial crosses were thus made with such objectives in view:

Milketan x Fortuna—Milfor
Milfor x Buenketan—Milbuen

IMPORTANT CHARACTERS OF THE PARENT PLANTS

For the purpose of isolating an ideal variety from among those under cultivation and of effecting through hybridization the blending of genetic combinations which would include most if not all the desirable qualities which, from the viewpoint of the rice breeder, a superior variety of rice should possess to meet the requirements of the growers, the millers as well as the fastiduous consumers, meticulous studies of the important morphological, genetical, physiological and ecological characters of the 32 leading local varieties (including the introductions and hybrids) were undertaken in 1940 to 1947. The results of these studies revealed that, although not one of the groups could qualify, they furnished some useful data which served as guideposts in picking out the desirable breeding materials for our purpose.

1. Ketan Koetoek.—Ketan Koetoek is a glutinous variety imported from French Indo-China. It is nonseasonal, good for

lowland and palagad planting, maturing in about 155 days and producing 50 to 80 cavans per hectare. It has a stocky, stiff stem of medium size and height which keeps the plant erect even under strong wind pressure; it has long, broad leaves and medium tillering; long, well exerted, compact and drooping panicles; plump, nonshattering grains with dark purple apiculus and large, oval, opaque kernels of good milling and eating quality. Very highly resistant to stunt and other common diseases and commercially resistant to stemborers. According to Dr. K. Ramiah, one of the foremost rice specialists of India, this variety has many things in common with *Oryza sativa* var. *indica* (*bulu* type[4] to which most of the Javanese varieties grown in Bali belong.

2. *Milagrosa.*—Milagrosa is a lowland, nonglutinous variety with excellent eating quality. It is seasonal, maturing in about 155 days and producing only 40 to 70 cavans per hectare because of the minuteness of its grains. It has a weak lodging stem, with narrow leaves and comparatively high tillering power; its panicles are short, compact, drooping with minute oval to round grains and white aromatic kernels. Very highly resistant to stunt, second only to Ketan Koetoek, as well as to other common diseases, but quite susceptible to stemborers. It belongs to *Oryza sativa* var. *indica* (*indica* type).[5]

[4] *Bulu* type.—After seeing Buenketan and Milketan at close range during his three visits to the Philippines in the last 5 years Dr. K. Ramiah remarked that they remind him of the Bulu type of rice being grown in the island of Bali Java. His description of the bulu type follows:

Stems erect and sturdy; leaves broad and long; tillering low to medium; panicles long and drooping with large nonshattering grains. Resistant to stemborers.

This description tallies very well with the description of Buenketan and Milketan in many respects.

In his article on "Rice Research in India" Ramiah(9) expressed the opinion that except for some of the rice grown in Japan, U. S. A. and Europe, all the rice varieties grown in South-East Asian countries including India belong to the same geographical race of the species, *Oriza sativa* var. *indica* and should cross freely with each other.

[5 and 6] *Indica* type and *japonica* type.—In the academic circle of Japan, Kato(6) in 1928 announced his classification of the rice varieties into two types—the *indica* type and the *japonica* type, the first (claimed to be not cross-pollinating readily with the second) being mostly confined to the South-East Asian countries like Taiwan, French Indo-China, Siam, India, China Proper, Hainan, Philippines, Celebes, Java, etc. and, the second, to Japan, U. S. A., and Europe.

3. Buenavista.—Buenavista is a new name for Kasungsong. Like Milagrosa, it is a lowland and palagad variety, nonglutinous with very good eating quality. It is nonseasonal, maturing in about 155 days and producing 45 to 75 cavans per hectare. It has a large nonlodging stem with broad leaves and medium tillering; long, compact, drooping panicles and medium-sized brown grains with white aromatic kernels. Very highly resistant to stunt, second only to Milagrosa as well as to other common diseases and commercially resistant to stemborers. By possessing many things in common with Ketan Koetoek, it may be classified under the group, *Oryza sativa* var. *indica* (*bulu* type).

4. Fortuna.—According to Jones, J. W.(5) Fortuna is a pure-line selection made in 1911 by C. E. Chamblis and J. M. Jenkins from the Pa Chaim variety imported by the United States from Formosa in 1905. It was introduced to the Philippines about two decades ago where it proves to be suitable to local climatic and soil conditions and yields well under upland and fairly well under lowland and palagad planting. It is nonseasonal, maturing in about 132 days and producing 50 to 80 cavans per hectare. It stands on a large fairly stiff stem, with broad, long leaves and medium tillering; it produces long, compact, drooping panicles, with large bluish purple grains sporting with dark purple apiculus and long, white, big kernels of good eating quality and high nutritional value. It is resistant to stunt as well as to other common diseases and commercially resistant to stemborers. Basing purely on its geographical origin and Kato's classification, Fortuna may be placed under the *japonica* type although its main characteristics are quite different from those of typical *japonica* type.[6] In

This system of classification by Kato is obviously not looked upon with favor by Iso(3) who expressed the opinion that, if geographical distribution is to be used as a basis for classification, it would be more reasonable to divide the rice varieties into *insular*-type and *continental*-type instead of *japonica*-type and *indica*-type, inasmuch as the Japanese varieties are only a local-variety group with comparatively simple variation.

Mizushima(7) in his study on sexual affinity among rice varieties, *Oryza sativa* L, where he used 100 varieties (25 Japanese, 14 American, 17 Javanese, 17 Chinese, 14 Indian, 2 Philippines, 6 Indo-Chinese, and 5 Hawaiian) stated in his conclusion that the rice varieties studied do not form two distinct groups separated in view of the affinity, but there exist six various groups whose affinity varies step by step from one extremity to another.

fact, it possessess more things in common with Ketan Koetoek and Buenavista and should be placed under the same group *Oriza sativa* var. *indica* (*bulu* type).

IMPORTANT QUALITIES OF A SUPERIOR VARIETY

The main aim of plant breeding and hybridization is the creation of better varieties and seeds, particularly with reference to their yielding power, which is governed by several inherent genetic factors aside from the influence of culture, environment, climate and soil. A variety should be considered superior only when it has most, if not all, of the following desirable qualities:

1. *High yield of 80 to 100 cavans or more per hectare.*—To the rice farmer or the rice land owner, the acquisition of a high yielding variety and the production of the maximum yield per hectare are enough to have. But to the rice breeder, these are not enough: a superior variety must also satisfy the millers and the consumers. The combination of the desirable qualities in a hybrid is his target which is not easy to reach, especially in the Philippines where rice research is new and the agricultural scientists are still fighting for recognition and for ample financial and moral support from their leader. Besides high tillering, high number and good length of fertile panicles, high number and good size of fertile grains per panicle, high total weight of full grains per stool which, all combined, constitute an index for high yield, there are at least five other qualities to consider before the high standard requirement for a superior variety may be fully met.

2. *Nonseasonal and early maturing to allow the planting of two crops a year.*—A farmer can easily produce two good crops of rice a year if he has at his disposal (*a*) a nonseasonal early maturing variety, (*b*) adequate supply of irrigation water during summer, and (*c*) the necessary fertilizers, green manures and composts to maintain the high fertility level of his land which is the counterpart of the high-yielding power of his improved seeds.

3. *High degree of resistance to the major diseases and pests particularly to stunt, blast and stemborers.*—No matter how agronomically productive a hybrid might be, unless it has been screened and selected to include among its good qualities a high degree of resistance to the major diseases and pests, its potentialities and utility will be limited, subject to the hazards of such enemies which abound in our rice fields whenever and wherever

climatological conditions become favorable for their invasion and attack.

4. Resistant to inclement weather conditions like drought, typhoon and flood.—With the unpredictable weather conditions still prevailing year in and year out, the only guarantee a farmer may have for the protection of his crop against the hazards of inclement weather is varietal resistance which, more often than not, turns out to be as important as adequate irrigation and proper drainage. This is especially true in typhoon-belt areas, in places where irrigation facilities are not available and in areas frequented by floods.

5. Stiff, stocky stem and nonshattering grains.—A rice plant possessed of a stiff, stocky stem and nonshattering grains stands upright with its fully developed grains intact on the panicles, and remains unperturbed even under pressure by strong wind. On the other hand, a lodged plant resulting from its weak straw develops chaffy grains besides posing a problem especially for mechanized harvesting. There is therefore no gainsaying the fact that a lodged plant reduces its productivity as well as the efficiency of its harvesting, be it by manual labor or by any farm machinery like the harvester-thresher combine. Moreover, the field recovery of a variety with shattering grains is reduced by about 10 to 20 per cent, depending on the degree of its shatterability.

6. Good milling quality with high percentage of recovery and head rice.—To the rice millers high field yield is not enough—it must be complemented by good milling quality with high percentage of recovery and head rice. This is possible when the ratio of kernel to hull is high, say, from 80 to 82 per cent kernel and from 20 to 18 per cent hull, coupled with a good consistency of the endosperm which is generally indicated by its transparency and freedom from visible fissures. The present standard varieties, especially those of the *indica* type which unfortunately constitute the greater portion of our stock, possess only 77 to 78 per cent kernel in contrast with 80 to 82 per cent or more of the improved type.

7. Good eating and culinary quality.—To the housewives and the consumers in general, it is not enough that a variety yields well and mills well. It must possess good table and culinary quality to satisfy. Good scent or flavor, translucent white endosperm free from chalky center and white abdominal marking, soft texture and high expandability denote excellent quality.

This requirement may vary slightly depending, of course, on individual or national preferences.

8. High nutritional value.—Last but not least is high nutritional value. From the dietician and human health point of view, this is as important as good eating quality. The comparative analysis made by the Institute of Science and the Institute of Nutrition between the new hybrids and the present leading standard varieties shows that varieties differ in their nutritional value and that the new hybrids are 2 richer than the latter in vitamins as well as in protein (Table 2). Of course, a good portion of these, especially the vitamins, is lost during non-too-careful processing.

TABLE 2.—*Comparative nutritive values of Milfor 6 and Scraup Kechil 36.*[a]

	Milfor 6	(Excess)	Scraup Kechil 36	(Excess)
		Per cent		*Per cent*
Moisture, gm/100 gm	8.98		9.19	2.2
Nitrogen, gm/100 gm	1.49	4.7	1.42	
Fat, gm/100 gm	3.38	20.1	2.69	
Crude Fiber, gm/100 gm	1.35	54.0	0.63	
Ash, gm/100 gm	1.60	11.8	1.41	
Calcium, mg/100 mg	6.27		10.41	39.8
Phosphorous, mg/100 mg	199.87		213.17	6.2
Iron, mg/100 mg	1.27	11.0	1.13	
Thiamine, mg/100 mg	0.588	39.6	0.355	
Riboflavin, mg/100 mg	0.063	41.2	0.037	
Niacine, mg/100 mg	6.85	32.47	4.63	
		215.17		43.3

[a] Analyses done by the Institute of Nutrition.

THE NEW HYBRIDS [7]

These new hybrids (Buenketan, Milketan, Milfor, and Milbuen) are the products of natural and artificial cross-pollination and constitute a distinct type of early varieties suitable for all kinds of culture, be it lowland, upland or palagad by the ordinary method of planting or by mechanization. Their nonseasonal characteristics and earliness in maturation fit them well for the double-cropping system which may be adapted in all areas where irrigation facilities obtain, instead of the present practice by the majority of the rice farmers of producing only one crop a year.

1. Buenketan.—Buenketan is a natural hybrid between Buenavista (Kasungsong) and Ketan Koetoek (Plate 1). It is a perfect blending of the *indica* type and *bulu* type. It is early and nonseasonal maturing in about 130 days and producing

[7] A new technique has been adopted in the selection of these new hybrids, a detailed description of which will be published in a separate paper.

80 to 160 cavans or more per hectare on fertile land or on properly fertilized soil. It possesses broad leaves with purple-striped leafsheaths supported on a stocky, stiff, purple-striped stem of medium height which keeps the plant practically erect even under the pressure of a strong wind. It has medium tillering; long, compact, drooping panicles; large, nonshattering grains with dark purple apiculus; good milling quality with high percentage of recovery and head rice; large, long, white kernels with very good eating quality characterized by the fine aroma and soft texture acquired from its parent plants, matched only by its high nutritional value. It is highly resistant to stunt and blast as well as to stemborers. Because of its nonlodging straw and nonshattering grains which make it quite resistant to typhoon and flood, it provides a good material for mechanized farming, particularly in the typhoon-belt areas like Leyte, Samar, the Bicol Provinces, Central and Northern Luzon.

Of the several strains of this hybrid, Beunketan 99 (7–8) is the best, with its flagleaves prominently towering the plants at blooming time but giving way to the panicles at maturity. Thus the plants are amply protected from the ravages of the Maya bird during dough stage (Plate 3 and Plate 5, Fig. 1). It is good for lowland and palagad planting. It may be classified under *Oryza sativa* var. *indica* (*bulu* type).

2. *Milketan.*—Milketan is another natural hybrid between Milagrosa and Ketan Koetoek (Plate 4, Fig. 1). As in Buenketan, it is a happy blending of the *indica* type and *bulu* type. While it has many things in common with Buenketan, it differs from the latter in having grains with very light purple apiculus and the plain leafsheath and stem without any shade of purple stripe. It is also quite early and nonseasonal and possesses both nonglutinous and glutinous strains which mature in about 135 to 140 days and produce 80 to 120 cavans or more per hectare on fertile land or on properly fertilized soil. The nonglutinous strain, Milketan 20, is definitely an improvement over Milagrosa for being nonlodging, nonseasonal, early maturing in 135 days and with its grains very much enlarged in size, resulting thereby in the material improvement of its yield and milling quality. The glutinous strain, Milketan 21, on the other hand, is maturing in 140 days, more stocky and has improved its yield and eating quality over that of Ketan Koetoek by the acquisition of bigger grains with the Milagrosa aroma which gives both strains the excellent table quality of

Milagrosa matched only by its nutritional value. As in Buenketan, both strains are good for lowland and palagad culture, either by mechanization or the ordinary way of planting. Both resistant to stunt and other common diseases and commercially cially resistant to stemborers. It may be classified under *Oryza sativa* var. *indica* (*bulu* type).

3. Milfor.—Unlike the preceding two hybrids, Milfor is an artificial cross between Milketan and Fortuna; hence, it is a triple blending of the *indica* type, *bulu* type and *japonica* type (Plate 4, fig. 2 and Plate 5, fig. 1), represented by Milagrosa, Ketan Koetoek, and Fortuna. It has acquired the versatile character of the male parent plant Fortuna which makes it adaptable to lowland, palagad, and upland planting. It is nonseasonal, maturing in 118 to 132 days and producing 80 to 140 cavans or more per hectare on fertile land or on properly fertilized soil. It has dark green narrow leaves and a stocky stiff stem of medium height which sustains the plant erect even under strong wind pressure or typhoon. It possesses good tillering with long, compact, drooping panicles; large, long, nonshattering grains with white kernels of good milling quality and high percentage of recovery and head rice. The fine aroma together with the soft texture which it has inherited from Milketan makes its quality excellent, matched only by its high nutritive value imparted by the Fortuna gene. It is highly resistant to stunt and other common diseases and commercially resistant to stemborers as well as to inclement weather conditions like drought, flood and strong wind. Because of its versatility and dual character, nonlodging straw and nonshattering grains, it is especially suited to mechanized farming.

There are three good strains, Milfor 6 (13–6) which matures in about 132 days and fares better under lowland condition; Milfor 39 which matures in about 120 days, ratoons well once or twice after the plant crop and Milfor 6 (1–2) maturing in 118 days and fares better on upland. All can be planted as palagad with excellent results. It may be classified under *Oryza sativa* var. *indica* (*indica* type).

4. Milbuen.—Milbuen is another product of artificial crossing between Milfor and Buenketan (Plate 4, fig. 2 and Plate 5, fig. 2). It is therefore a quadruple genetic blending of Milagrosa, Buenavista, Ketan Koetoek, and Fortuna, representing the *indica* type, *bulu* type, and *japonica* type. It has at least three very good strains which are nonseasonal, early maturing in 115 to

Table 3.—*Showing the main characters and commercial possibilities of the new rice hybrids compared with the best of the present standard rice varieties.*

Culture No.	Hybrids and varieties	Cultural requirements[1]	Flowering habit	Growing period (days)	Stalk (height)	Flag leaf (size)	Panicle: Average number	Panicle: Average length	Grain: Total weight per plant	Grain: Average weight per 1,000	Grain: Number per panicle	Grain: Color per apiculus[2]	Size	Average weight per 1,000	Percentage	Kernel: Color	Kernel: Size
					cm	cm		cm	gm	gm			mm	gm			mm
1	Buenketan 99 (7-8-1)	L-P	Nonseasonal	128	148.7	47.4 × 1.25	15.1	31.75	58.2	28.5	175	DP	9.13×3.06×2.38	23.00	80.70	White	6.79×2.54×1.88
2	Buenketan 10 (7-1-1)	L-P	do	133	140.0	45.0 × 1.25	14.8	31.29	62.5	28.6	185	DP	9.16×3.00×2.30	23.50	82.20	White	6.30×2.50×1.90
3	Milketan 20 (1-1-1)	L-P	do	135	135.0	40.0 × 1.25	12.6	30.0	47.0	37.5	180	P	9.31×3.32×2.30	30.50	82.50	White	7.28×2 7 ×2.02
4	Milketan 21 (1-6-2)	L-P	do	140	120.0	35.0 × 1.25	12.0	31.25	52.5	36.5	202	P	9.69×3.51×2.29	28.50	78.00	Opaque	7.25×2 83×1.96
5	Milfor 6 (13-6)	L-P-U	do	132	135.0	36.00 × 1.25	13.0	31.00	45.5	33.6	125	LP	9.80×3.40×2.25	27 50	81.80	White	7.50×2.50×1.95
6	Milfor 39	L-U-P	do	120	130.75	38.75 × 1.25	13.5	30.5	44.3	34.5	110	LP	9.74×3.24×2.26	28.00	81.10	White	7.45×2.61×1.96
7	Milfor 6 (1-2)	U-L-P	do	118	130.00	36.5 × 1.25	12.9	30.9	47.3	33.5	100	LP	9.89×3.05×2.30	27.00	80.60	White	7.563×2.94×1.978
8	Milbuen 5 (10-7)	P-L-U	do	115	130.00	38.75 × 1.25	17.7	32.5	65.0	38.5	138	P	10.46×3.65×2.35	31.2	81.00	White	7.25×2 67×1.96
9	Milbuen 6	L-P-U	do	122	129.0	36.9 × 1.25	18.5	31.8	55.0	37.7	140	P	10.01×3.3 ×2.29	30.6	81.10	White	7.48×2.262×1.91
10	Milbuen 3 (8-4)	L-P-U	do	120	125.0	30.0 × .625	18.8	28.75	56.6	29.5	130	P	9.20×3.08×2.17	24.0	81.30	White	7 06×2.50×1.38
11	Fortuna (9-4)	U-L-P	do	132	157.5	70.0 × 1.87	9.0	32.5	40.00	28.85	125	DP	10.21×3.13×2.04	24.10	80.00	White	7 77×2.51×1.75
12	Buenavista (Kasungsong)	L-P	do	150	150.1	66.0 × 1.75	9.0	30.55	36.0	24.35	130	B	8.65×2.94×1.90	18.40	77.85	White	6.35×2.51×1.65
13	Ketan Koetoek	L-P	do	150	147.5	69.0 × 1.87	9.0	34.0	40.0	31.00	125	DP	8.4 ×3.48×2.33	25.00	80 61	Opaque	6.03×2.87×2.06
14	Milagrosa	L	Seasonal	155	145.7	66.0 × .625	16.0	27.50	30 0	15.0	135	B	6.49×2.59×1.33	11.50	78 66	White	4.74×2.21×1.61
15	Elon-elon	L	do	193	158.0	67.0 × .625	19.0	29.00	65.00	22.50	126	B	8.17×2.82×1.97	17.50	77.77	White	6.23×2.31×1.72
16	Raminad Str. 3 (Quezon)	L	do	190	160 0	68.0 × .625	13.0	27.50	63.0	24.30	128	B	8.58×2.97×2.00	18.85	77.57	White	6.39×2.44×1.71
17	Wagwag A	L	do	210	120 0	48.0 × .625	22.0	27.50	60.6	17 00	131	B	7.50×2.60×1.79	13.40	78.82	White	5.52×2.22×1 85

Culture No.	Hybrids and varieties	Endosperm[3]	Resistance to: Stunt	Hel. spot	Blast	Stem borers	Lodging	Shattering	Drought	Flood	Computed yield per hectare	Milling quality: Recovery	Milling quality: Head rice	Culinary and table qualities	Nutrition value: Vitamins[4]: Thiamine	Riboflavin	Niacine	Crude protein (Nx6.25)
											Cavans	Per cent	Per cent					
1	Buenketan 99 (7-8-1)	CS	+++	++	+++	+++	++	++	++	+++	157.7	7[illegible].40	66.17	V. Good	0.444	0.082	5.71	11.3
2	Buenketan 10 (7-1-1)	CS	+++	++	+++	+++	+++	++	++	+++	167.2	70.80	65.00	V. Good				
3	Milketan 20 (1-1-1)	CS	+++	++	+++	++	++	++	++	+++	120.0	69.00	65.48	Excellent				
4	Milketan 21 (1-6-2)	GS	+++	++	+++	++	+++	++	++	+++	116.0	66.95	64.12	Excellent	0.659	0.111	6.32	10.60
5	Milfor 6 (13-6)	CS	+++	++	++	++	+++	++	+++	+++	126.0	69.00	64.00	Excellent				
6	Milfor 39	CS	+++	++	++	++	+++	++	+++	+++	120.0	68.90	63.38	Excellent	0.471	0.114	7.02	9.00
7	Milfor 6 (1-2)	CS	+++	++	++	++	+++	++	+++	+++	123.9	69.33	64.47	Excellent				
8	Milbuen 5 (10-7)	CS	+++	++	+++	++	++	++	+++	+++	125.0	70.62	65.44	Excellent				
9	Milbuen 6	CS	+++	++	+++	++	++	++	+++	+++	132.2	69.00	66.10	Excellent				
10	Milbuen 3 (8-4)	CS	+++	+++	+++	+++	++	++	+++	+++	129.7	70.60	64 67	Excellent				
11	Fortuna (9-4)	C	+++	++	+++	+	++	+	++	++	90.5	63.50	62.27	V. Good	0.538	0.083	5.47	11.00
12	Buenavista (Kasungsong)	CS	+++	++	++	++	+++	++	—	+ +	86.5	65.80	60.53	V. Good				
13	Ketan Koetoek	G	+++	++	++	++	+++	+++	—	+++	95.0	68.80	63.98	Good				
14	Milagrosa	CS	+++	++	++	++	—	+	—	+	79.0	65.60	62.22	Excellent				
15	Elon-elon	C	++	+	+	++	++	+	—	+	96 0	65.97	58.96	V. Good	0.378	0.108	4.26	9.61
16	Raminad Str. 3 (Quezon)	C	++	++	++	+	—	++	—	+	110.0	64.32	50.16	V. Good	0.373	0.104	4.71	9.30
17	Wagwag A	C	++	++	+++	++	++	—	—	+	108.5	63.00	52.70	V. Good	0.324	0.043	3.21	5.40

[1] L, Lowland; P, Palagad; U, Upland.

[2] P, Purple; LP, Light Purple; DP, Dark Purple; B, Brown.

[3] C, Common; G, Glutinous; S, Scented.

122 days and producing 80 to 150 cavans or more per hectare. The Milbuen strains have acquired the blending of many fine qualities which, from all indications, may surpass their parentage not only in yield of excellent quality rice but also in resistance to diseases and pests particularly to stunt, blast and stemborers, as well as to inclement weather conditions like drought, typhoon and flood. They are versatile like the Milfor strains and may be planted as lowland, palagad and upland all the year around in the important rice areas of the Philippines whenever and wherever irrigation facilities avail, or in places where the annual distribution of rainfall is more or less uniform throughout the year.

There are three selected strains of this versatile hybrid: Milbuen 3. Milbuen 6, and Milbuen 5, with their main characteristics given in Table 3. They may be classified under *Oryza sativa* var. *indica* (*indica* type).

THE COMMERCIAL POSSIBILITIES OF THE NEW HYBRIDS

Because any new hybrid to be of intrinsic value must have its commercial possibilities which, in turn, depend on its inherent qualities to satisfy the demands of the farmers, the millers and the consumers as well, the author presents in Table 3, 10 strains of the new hybrids, Buenketan, Milketan, Milfor and Milbuen, and 7 of the standard commercial varieties showing all their important characters and productive capacities.

From this table it can be seen that the new hybrids are superior to the present standard commercial varieties in many respects, be it in yield, in reaction to diseases and pests, in resistance to inclement weather conditions such as drought, typhoon and flood, in earliness of maturity with more resiliency in flowering habit to allow planting of two crops a year, in suitability to all types of planting and kinds of farming operation most particularly mechanization, in reaction to heavy soil fertilization without the ill effects of lodging resulting from the production of surplus vegetative growths, in milling and table qualities, and in nutritional value. There is no doubt, therefore, that the adoption of the new hybrids, considering their great potentialities and commercial values, will be a great factor in the final solution to our perennial problem of rice shortage.

SUMMARY

1. This work forms part of an overall program of improving the Philippine rice industry in all its technical aspects to make

the Philippines self-sufficient in good-quality rice at a reasonably low cost well within the reach of the common people and with enough surplus to supply a portion at least of the requirements of rice-deficient neighbor countries like Hongkong and Japan.

2. Four new rice hybrids, Buenketan, Milketan, Milfor and Milbuen are presented with their important characteristics and commercial possibilities. They may be classified under *Oryza sativa* var. *indica*.

3. As far as can be determined, there are no material differences between a natural hybrid and an artificial hybrid. The utility and value of each would seem to depend largely on the combination or combinations of the inherent genetic characters involving the desirable qualities which must have been materially influenced by the individual parentage as well as by the criteria used and the technique adopted in the selection and stabilization of the desired strains.

4. Like other domesticated plants, the productive capacity of rice is directly affected by several interrelated factors such as the inherent genetic characters of the seed, diseases and pests, soil fertility, availability of adequate irrigation water or sufficient soil moisture for the sustenance of normal growth and development, cultural methods used as well as the prevailing ecological factors.

5. Rice improvement work in other countries has shown (*a*) that of the three known methods of crop improvement for higher yield, better quality, greater resistance to diseases and pests and to inclement weather conditions, hybridization and selection have invariably given the maximum benefit; (*b*) that in properly implementing these findings, Japan which has been spending and is still spending large sums of money for rice breeding and research studies in general presently employs 94 rice breeders as against 18 of India, seven of Italy, six of Portugal, five of Egypt, five of Pakistan, and three of the Philippines.

6. As a result of her effort in improving her rice industry through the application of scientific methods, Japan now ranks third among the leading rice-producing countries of the world, not only in volume of production but especially in average yield per hectare.

7. Notwithstanding her favorable climatic and soil conditions, the Philippines stand last among the 14 leading rice-producing

countries of the world, as a result of government indifference in providing enough funds and facilities for rice research.

8. That there is plenty of room for the genetic improvement of the present Philippine standard rice varieties and, therefore, of the Philippine rice industry as a whole through meticuluous hybridization and selection, is beyond any reasonable doubt. This is clearly shown in Table 3.

9. There is now every reason to believe, therefore, that what Japan has accomplished in the improvement of its rice industry, through the application of scientific processes in which hybridization plays the most important role, can be duplicated by the Philippines in due time provided, however, that the moral backing and financial support of the Philippine Government are forthcoming.

RECOMMENDATIONS

To attain self-sufficiency in good quality rice that would cost reasonably low within the shortest time possible, inferior varieties with which the greater portion of our rice land, particularly the rain-fed areas, should be replaced with the new hybrids particularly with Buenketan, Milfor and Milbuen.

To maintain our seed improvement program and continue its development in all its technical phases as means of increasing production, an office charged with this function, and dedicated to the improvement of the rice industry as a whole should be created.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Kernels of Buenavista, female parent, x–1.
2. Kernels of Ketan Koetoek, male parent, x–1.
3. Kernels of Kuenketan, hybrid parent, x–1.
4. Kernels of Milagrosa, female parent, x–1.
5. Kernels of Ketan Koetoek, male parent, x–1.
6. Kernels of Milketan (nonglutinous), hybrid x–1.
7. Kernels of Milketan (glutinous), hybrid x–1.

PLATE 2

FIG. 1. Kernels of Milketan, female parent, x–1.
2. Kernels of Fortuna, male parent, x–1.
3. Kernels of Milfor, hybrid parent, x–1.
4. Kernels of Milfor 6, female parent, x–1.
5. Kernels of Buenketan 99, male parent, x–1.
6. Kernels of Milbuen, hybrid parent, x–1.

PLATE 3

FIG. 1. Buenketan 99, at dough stage with characteristic flagleaves towering the heads, which protect the milky grains from ravages of birds. Plants on left were planted two days ahead of those on right.
2. Buenketan 99, at maturing stage, with most of the flagleaves having folded down, giving way to the panicles.

PLATE 4

FIG. 1. Milketan 20, approaching maturation period. Note the long drooping panicles heavily laden with large fully developed long grains.
2. Milfor 6, left, and Milbuen 3, right, both approaching maturation period. Note the heavier shade of former in contrast to the more profused tillering of latter. Spacing in all cultures was 20 x 20 cm and seedling was one seedling per hill.

PLATE 5

FIG. 1. Buenketan 99, approaching maturation, at which stage most of the flagleaves are still towering the heads, a distinguishing character inherited from the female parent Buenavista.
2. Milbuen 3, fully matured. Note that all the panicles are towering while the flagleaves are down, a distinguishing character inherited from the male parent Fortuna.

PLATE 6

FIG. 1. Milfor 6, matured, with President Ramon Magsaysay, fingering the grains and panicles.
2. President Ramon Magsaysay, with a group spectators admiring the magnificent performances of the newly developed hybrids.

PLATE 7

President Ramon Magsaysay and the author viewing closely one of the newly developed hybrids.

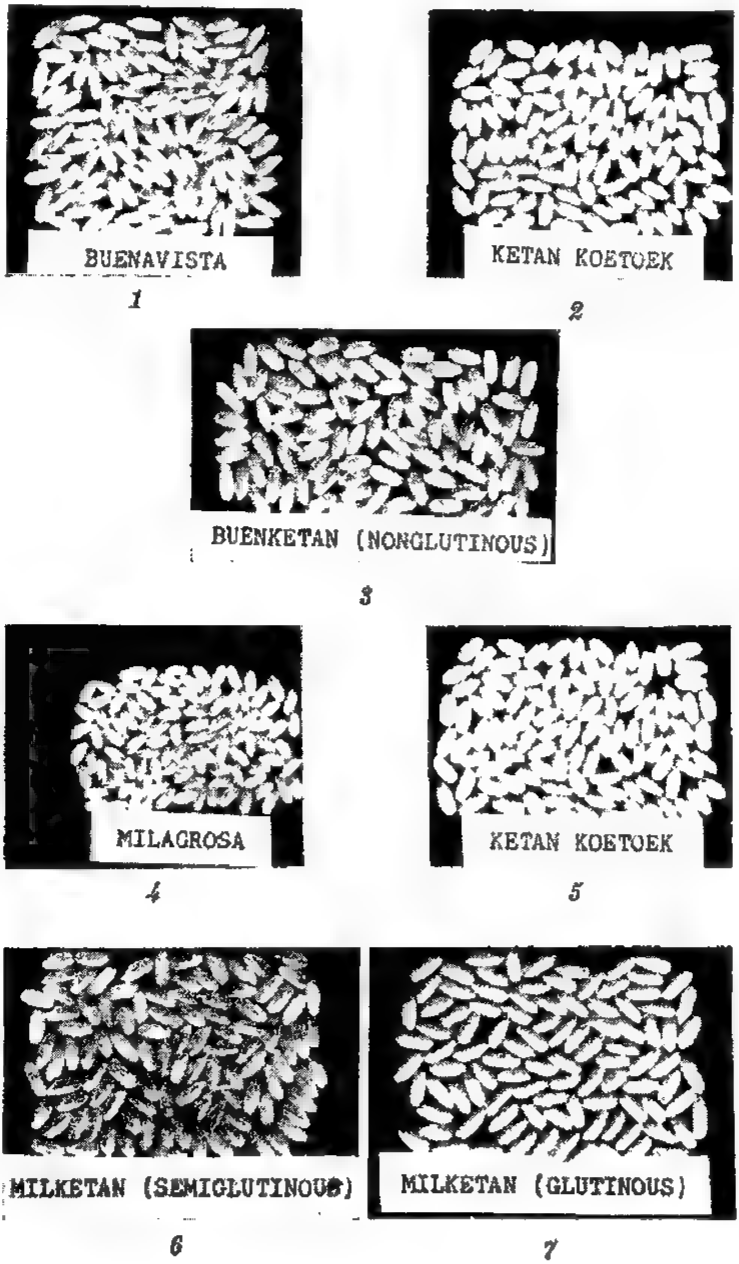
BUENAVISTA
1
KETAN KOETOEK
2
BUENKETAN (NONGLUTINOUS)
3
MILAGROSA
4
KETAN KOETOEK
5
MILKETAN (SEMIGLUTINOUS)
6
MILKETAN (GLUTINOUS)
7

PLATE 1.

1

2

PLATE 3.

1

2

PLATE 4.

1

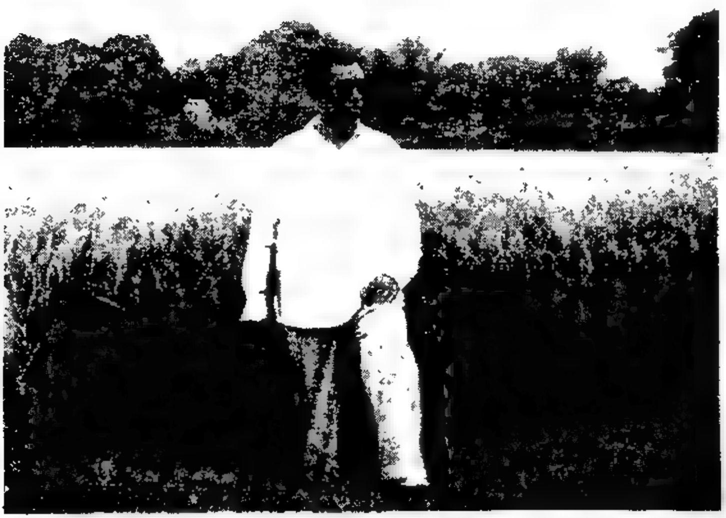

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PLATE 5.

1

2

PLATE 6.

PLATE 7.

NOTES ON ARADIDÆ FROM THE EASTERN HEMISPHERE, X (HEMIPTERA)

ON SOME APTEROUS MEZIRINÆ FROM INDIA AND INDONESIA

By Nicolás A. Kormilev
Buenos Aires, Argentina

NINE TEXT FIGURES

Through the kind office of Dr. Eva Halaszfy, Keeper of the Department of Zoology of the Hungarian National Museum in Budapest, to whom I express my sincere gratitude, I was able to examine a certain number of apterous Aradidæ from India and Indonesia. The specimens examined belong to four genera and five species, of which two genera and four species are described as new further below.

Subfamily MEZIRINÆ Oshanin

Tribe CARVENTINI Usinger

Genus CHELYSOSOMA novum

Elongately subtriangular, rather flat, but concave on the dorsal and convex on the ventral surface; antennæ and legs covered with strong, short, inclined bristles, the body is without them; entire body, antennæ and legs covered with thick reddish-brown incrustation, completely disguising the genuine color of them.

Head subquadrate, posteriorly rounded, less long on the median line than wide across the eyes; anterior process short, conical, projecting only a little beyond the base of the first antennal joint; antenniferous spines dentiform, divergent, do not reach the tip of the anterior process; eyes small, semiglobose, protruding; the postocular borders rounded, unarmed; the vertex with V-shaped median ridge and slender infraocular carinæ. Antennæ strong and long, almost three times as long as the head; the first joint clavate, the second and third cylindrical, the fourth pyriform; the third the longest, the fourth the shortest, the first longer than the second. Rostrum short, reaches the hind border of the rostral grove.

Pronotum much shorter on the median line than wide across the humeri; collum indistinct; the anterior border roundly cut out; the outer borders, each with two tubercles, the first located a little before the middle, and the second at the humeral angle;

the anterior angles dentiform, directed forwards; the disk concave and feebly elevated on the median line, laterally to it with a few irregular pits and furrows, along the lateral borders with two (1+1) strongly elevated S-formed ridges; the posterior border convex, rounded.

Mesonotum much shorter on the median line than wide across the postero-lateral angles; the disk is concave and with a median deep furrow; the lateral borders raised and provided with two (1+1) high sublateral ridges, half fused with the former, and with four (2+2) tubercles found on the borders; the posterior border is convex, rounded in the middle and roundly cut out laterally.

Metanotum is divided into two (1+1) rounded plates, posteriorly fused with the first tergite, without distinct limit; the latter is fused posteriorly with the second tergite, the limit marked by a thin curved carina.

Abdomen much longer (the measurement is taken from the fore border of the first tergite to the tip of the ninth) than wide across the fourth segment (the maximal width), separated into three plates, the first is formed by the second tergite; the second by the third to sixth tergites fused together, and the third by the posteriorly raised (more in the male) seventh tergite. Along the median line of the abdomen run two, more or less separated longitudinal carinæ, laterally to them are placed on each segment and each side one big, and exteriorly to it, two smaller round depressions; the connexivum is raised exteriorly, and deeply depressed along the outer border; the latter on each segment posteriorly provided with a round tubercle. The seventh tergite of the male is raised backwards for the reception of a vertical hypopygium, caudal in position; the latter is rather flat, with a round elevation in the middle of the upper border, and a median carina beneath this elevation; the genital lobes are small, ovate, and with the spiracle terminal. The seventh tergite of the female is elevated, but depressed in the middle of the disk; the genital lobes are small, subtriangular, and with the spiracle terminal; the ninth segment is conical, caudal in position, placed at lower level than the genital lobes, but higher than the genital plates. Spiracles of the second segment are sublateral (ventral) and slightly visible from above; the spiracles of the third to seventh segments are ventral, placed near the lateral margin, but not visible from above. The scent gland openings are not visible from side.

The legs are long and rather thin, unarmed.

Genotype.—*Chelysosoma halaszfyi* sp. nov.

This curious genus is rather isolated systematically in the tribe Carventini; the shape of the head and the notum, and particularly pilose antennæ and legs are not known in other genera of this tribe.

1. CHELYSOSOMA HALASZFYI sp. nov.

Male.—Reddish-brown to reddish, shiny, but the genuine color of the body is entirely disguised by a thick reddish-brown incrustation; the rostrum and tarsi testaceous. Fig. 1.

Head less long on the median line than wide across the eyes (male, 25:29; female, 26:31; the proportions of the antennal joints (1–4) are: male 20:15: 27:11; female, 23: 16:27: 11.

Pronotum is less long on the median line than wide across the humeri (male, 23:45; female, 25:53); the second tergite has a median depression in the form of an inverted pear, which runs till far beyond the fore borders of the lateral round depressions.

Abdomen far longer than wide (male, 103:74; female, 119:92); the maximal width is across the fourth segment. The hind tibia is as long as the first and the second antennal joints together (35:35). Figs 2 and 3.

Chelysosoma halaszfyi gen. nov., sp. nov.

FIG. 1. Female, seen from above.
2. Male, the apex of the abdomen seen from side.
3. Male, apex of the abdomen seen from behind.

Total length: male, 6.12; female, 6.95 mm; width of the pronotum, male, 1.62; female, 1.87 mm; width of the abdomen, male, 2.69; female, 3.56 mm.

Holotype.—Male, India, Madura—Jos. Dubreuil coll.; deposited in the Hungarian National Museum, Budapest.

Allotype.—Female, collected with the holotype; in the same collection.

Paratype.—Male, collected with the holo- and allotype; in the collection of the author.

It is a pleasure to dedicate this curious species to Dr. Eva Halaszfy.

Tribe MEZIRINI Usinger

Genus CHELONOCORIS Miller, 1938

Chelonocoris MILLER, Ann. Mag. Nat. Hist. (11) 1 (1938) 500.
Chelonocoris USINGER, Zool. Meded. (22) 32 (1954) 259.

This curious genus, the first of those described as apterous Aradidæ, was recently revised by Dr. R. L. Usinger [(1954) 259–278]. When his manuscript was in press, I received two specimens of *Chelonocoris*, one of which turned out to be *C. bloetei* Usinger, from Sumatra, and another a new species, closely allied to *C. bufo* Miller, described from Malaya, but in the key of Dr. Usinger [(1954) 262] running to *C. dyak* Miller, described from Borneo. The new species also was found in Borneo. As Dr. Usinger has noted, Dr. W. E. China has called his attention to the fact that "the Borneo fauna is closely allied to that of Malaya" and that one "could get the same species of *Chelonocoris* occurring there and in Malaya" [(1954) 261].

At first I was inclined to identify this specimen as *C. bufo* Miller, because the general appearance and the majority of the measurements taken on it are not divergent from the drawing of Miller more than it is possible in the normal specific variations, but three factors have forced me to give up this idea, and describe this species as new: this specimen is smaller, only 16 mm in length, being similar to *C. dyak* Miller, whereas *C. bufo* Miller is bigger, 17.5 mm (both specimens are females); then, the femora are distinctly "naked", only with short tomento, but almost without longer, curled hairs, present in *bufo*, and which are a distinctive character between *bufo* and *dyak* in the key of Usinger; and at least, the locality of this specimen is Borneo, whereas *C. bufo* was described from Malaya, as I have mentioned anteriorly. The apterous Aradidæ, lacking the wings and with slow movements, have little possibility to spread, therefore are inclined to form numerous endemic species, with

a small area of distribution. Borneo is relatively remote from Malaya, and while it is possible that both these localities could have the same macropterous species, or those with better capability for spreading, it is very improbable that they can have the same apterous Aradidæ.

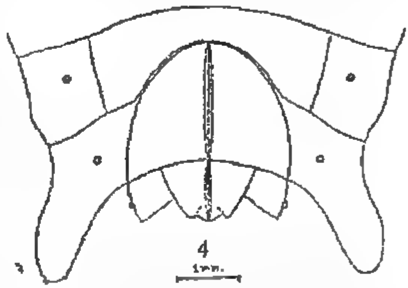
2. CHELONOCORIS BLOETEI Usinger, 1954.

Chelonocoris bloetei USINGER, Zool. Meded. (22) 32 (1954) 271, *figs. 5, 6.*

One male, Indonesia, West Sumatra, Padang Pandjang—H. Rolle coll. (Mus. Nat. Hung.).

3. CHELONOCORIS USINGERI sp. nov.

Female, black; the first rostral and the first tarsal segments chestnut brown; the second tarsal segment piceous; the tomento rufous. The body is covered with thick, short tomento; the first antennal joint more, the second and third less covered with long curled hairs; the femora are "naked," with tomento only, but almost without longer hairs, similarly to *C. dyak*, with which I could compare the new species.



Chelonocoris usingeri sp. nov.
FIG. 4. Female, the apex of the abdomen seen from below.

Head longer than wide across the eyes (30:20); the anterior process cleft, the lobes acute and parallel, reach to one-fifth of the first antennal joint; the antenniferous spines stout, exteriorly convex, reach to one-half of the anterior process. Antennæ very long and stout, typical for the genus; the proportions of the joints (1–4) are 20:11:22:8; the ratio between the length of the first antennal joint and the hind tibia is 40:37.

Pronotum is shorter on the median line than wide across the humeri (20:34); collum roundly cut out anteriorly; the lateral borders convex, rounded; the disk in the middle with two longitudinal carinæ, convergent and anteriorly fused together, forming an inverted "V"; behind these carinæ runs a median sulcus, and, laterally to it, there are two (1+1) low, round, tubercles. Mesonotum, metanotum and abdomen with usual pattern of round depressions and elevations; the median ridge

is high, rising backwards continually, from the mesonotum, across the metanotum, till a median, rhomboid, depression between the third and fourth tergites, then declivous backwards. The limits between the meso and metanotum, and between the metanotum and the abdomen, are hardly noticeable.

Abdomen broad and rather flat, longer than wide (78:69), the measurements having been taken from the anterior border of the second tergite till the tip of the ninth segment, and across the fifth abdominal segment respectively. The lateral borders of the abdomen convex, rounded; the lobes of the seventh segment long, divergent, gently tapering till the apex, the latter narrowly rounded; the length of the lobes (from the limit between the sixth and seventh connexiva till the tip of the lobe) is equal to the width across the genital lobes (27:27); the upper inflation of the tergum is half as high as the depth of the venter (9:18); the genital lobes of the eighth segment as long as the ninth. Other characters as in *C. bufo* Miller. Fig. 4.

Female, total length (measured from the tip of the jugæ till the tip of the lobes of the seventh abdominal segment), 16.0 mm; width of the pronotum, 3.2 mm; width of the abdomen, 6.6 mm.

Holotype.—Female, Borneo—Xantus coll.; deposited in the Hungarian National Museum, Budapest.

It is a pleasure to dedicate this species to Prof. Dr. Robert L. Usinger of the University of California, Berkeley, who has recently revised this genus.

Genus CHELYSOCORIS Miller, 1949

Chelysocoris Miller, Bull. Raffles Mus., Singapore 19 (1949) 42.

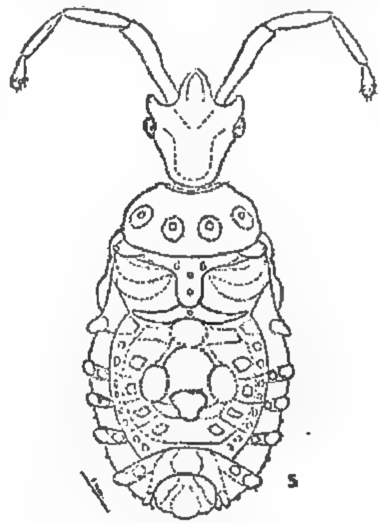
This genus was erected by Miller for the reception of a single species, *C. gibbus* Miller, 1949, described from Borneo, Sarawak. Now I am able to describe the second species, also from Borneo, named *C. arachnoides* sp. nov.

Miller put his genus in the subfamily *Chelonocorinæ* Miller, 1938, but this subfamily is not tenable, as Usinger has proved in 1941 [(1941) 169], and both genera of it, *Chelonocoris* Miller and *Chelysocoris* Miller, belong to the subfamily Mezirinæ Oshanin, tribe Mezirini Usinger.

4. CHELYSOCORIS ARACHNOIDES sp. nov.

Male.—The head is big, subtriangular, its maximal width is

across the antenniferous tubercles; regularly narrowing backwards behind the eyes, without any tooth or tubercle. The body, excepting the head, is ovate; on the dorsal surface rather flat, but on the pronotum are placed transversally four round tubercles, the mesonotum is raised on the median line, this elevation posteriorly is fused with the high, central gibba of the dorsum; the seventh tergite, including the hypopygium, also strongly raised. The ventral surface is convex. The head, body, antennæ and legs are covered with short, strong, erect bristles, which accumulate the dirt, so that the surface of the body is completely covered with it, only the meso-, metasternum, and the venter, are free of it, naked and shiny. Some of these bristles are longer, and make a second stratum. Fig. 5.



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Chelysocoris arachnoides sp. nov.
FIG. 5. Male, seen from above.
6. Body of the same seen from side.

Head longer than wide across the eyes (28:23); anterior process short, conical, reaches to one-third of the first antennal joint; antenniferous tubercles are very short, obtuse, scarcely project beyond the base of the first antennal joint, and reach to one-third of the anterior process; eyes small, prominent, the postocular part of the head is as long as the anteocular; the rostral groove is long and narrow, posteriorly closed, filled with the rostrum, which reaches to its posterior border. Antennæ are strong and long, more than twice as long as the head (58:28); the first antennal joint is robust and subapically slightly curved outwards; the second and third cylindrical, the fourth pyriform; the proportions of the joints (1–4) are 22:15:13:8.

Pronotum is half as long as wide across the humeri (16:33); collum indistinctly separated from the disk; lateral borders

convex, rounded; there are four (2+2) round tubercles on the disk, the inner ones being higher.

Mesonotum with two (1+1) transversal depressions laterally and a median ridge, regularly raised backwards and fused with the elevated first tergite, and the central gibba of the tergum respectively; on this ridge are placed in a longitudinal row three small pits, two on the mesonotum and one on the first tergite. On the outer border of the mesonotum are placed two (1+1) round, tubercles.

Metanotum is separated into two plates, placed laterally to the median ridge of the mesonotum; each of these plates is transversally depressed on the disk, and before this depression raised in a short, transversal ridge, fused together with the posterior border of the mesonotum.

Abdomen is separated into three plates; the first is occupied by a short, transversally inflated, first tergite, posteriorly fused with the central gibba; the second plate is formed by a central gibba, in which are fused together the second to sixth tergites; the third plate is formed by the seventh tergite and hypopygium. The first tergite laterally does not reach the lateral border of the abdomen. The central gibba is strongly raised, its height is half as high as the venter is deep, counting from the upper border of the connexivum, Fig. 6; the top of the gibba is rather flat in the middle, but provided with four round tubercles, disposed on the periphery in the shape of a cross; the lateral and hind borders of the gibba are strongly declivous, and have the usual pattern of bigger and smaller round depressions. The central gibba posteriorly is separated from the seventh tergite by a deep transversal depression, therefore the seventh tergite is strongly raised backwards. Hypopygium is dorso-caudal in position, and not visible from below; seen from behind, it has the form of an ovate vertical plate; seen from above it is twice (1+1) longitudinally depressed, the median ridge being higher and longer than the lateral. Connexivum is raised on the exterior borders, and there provided on each segment with two, obliquely placed, tubercles forming a short ridge. Spiracles are lacking on the second (the first visible) connexivum; ventral and not visible from above on the third and fourth; sublateral and slightly visible from above on the fifth to seventh; terminal on the genital lobes eighth. Sternites second to seventh are naked, without usual pattern of round spots; the seventh is very big, placed horizontally; the eighth (male) is seen from behind

as two (1+1) small, vertical, elongate plates, terminating with the genital lobes.

Prosternum and pleura are covered with short bristles and the accumulated dirt. The scent gland openings are narrow, long and slightly curved, placed in the postero-superior angles of the mesopleura.

Legs are strong and long, unarmed, but covered with long, erect bristles; the hind femora are almost twice as long as the first antennal joint (40:22); the hind tibiæ are shorter, one and a half times as long as the first antennal joint (33:22); the tarsi are slender; the ratio between the joints of the hind tarsi (1–2), the measures taken from below, are: 1.5:5.

Color of the naked parts of the body is chestnut-brown; if the dirt is cleared, the color below it is also chestnut-brown.

Male, total length, 10.0 mm; width of the pronotum, 3.14 mm; width of the abdomen, 4.76 mm.

Holotype.—Male, Indonesia, Borneo—Xantus coll.; deposited in the Hungarian National Museum, Budapest.

The new species looks like a spider; differs from *C. gibbus* Miller by the conical anterior process, much shorter and blunt antenniferous tubercles, the central gibba is almost horizontal on the top, not declivous forwards, the depression between the central gibba and the seventh tergite is deeper, etc.

Genus PARAPICTINUS novum

Ovate, rather flat; the median ridge of the central dorsal plate slightly elevated, the seventh tergite in the male more, in the female less raised backwards. The head, antennæ, pronotum and legs covered with rough setigerous granulation; the rest of the body with dispersed, short, erect bristles.

Head shorter on the median line than wide across the eyes; anterior process short, triangular, does not reach the middle of the first antennal joint; the jugæ slightly longer than the tylus and anteriorly contiguous; antenniferous spines short, dentiform, divergent, do not reach the tip of the anterior process; eyes small, semiglobose, protruding, with convex facetæ; infra-ocular carinæ low and slender; postocular borders unarmed, convergent backwards. Antennæ stout, more than twice as long as the head; rostrum short, reaching the hind border of the rostral groove.

Pronotum trapezoidal, less than half as long on the median line as wide across the humeri; anterior border subtruncated, only the rounded anterior angles are slightly prominent; collum

indistinct; lateral borders straight, divergent backwards and crenate; the hind border slightly cut out; the disk in the middle anteriorly with a semicircular carina, its horns are directed backwards; behind and laterally to this carina slightly depressed.

Mesonotum subtriangular with the tip broadly rounded, in the shape of a scutellum; flat; the disk elevated in the middle and with two (1+1) short baso-lateral carinæ; laterally mesonotum does not reach the lateral borders of the body, being separated from them by the plates of the metanotum.

Metanotum separated into two (1+1) subtriangular plates, slightly convex; only the antero-exterior angles of these plates reach the outer borders of the body near the scent gland openings.

Abdomen in both sexes is longer than wide (measured from the fore border of the first tergite till the tip of the ninth abdominal segment); its lateral borders are strongly convex, rounded. Abdomen is divided into three plates, separated from each other and from the connexivum by fine depressions or furrows. The first plate is formed by the first tergite, which is transversal scarcely narrower than the second. The second plate is formed by the second to sixth tergites, fused together in the central plate of the tergum; this plate is subquadrangular, slightly raised along the median line (the median ridge), laterally depressed, and each segment provided with two (1+1) big round spot, and exteriorly to them with four (2+2) small pits. The third plate is formed by the raised seventh tergite, which is much more raised in the male than in the female. The hypopygium is caudal in position, and similar to that of the genus *Odontonotus* Kormilev [(1955) 34], on the dorsal surface produced backwards into a big pointed lobe; on the ventral surface semi-globose and shorter; the genital lobes are small, clavate. In the female the genital lobes are subtriangular, small and short; the ninth segment subtriangular, much bigger and much longer, protruding backwards. Spiracles of the second to sixth segments ventral, placed near the lateral margin, but not visible from above; those of the seventh and the genital lobes lateral and visible from above. The seventh sternite is only once cut out on the posterior border in the middle.

The scent gland openings are long and straight, placed in the postero-superior angles of the mesopleura. Legs are unarmed.

Genotype.—Parapictinus ovatus sp. nov.

The new genus at first sight is similar to some American species of the genus *Pictinus* Stål (1873) particularly the head, antennæ and pronotum being alike, but the head is unarmed behind the eyes, and the genital segment of the male is similar to that of the genus *Odontonotus* Kormilev (1955); the females of *Odontonotus* are not known yet, so the female of the new genus cannot be compared with them. From *Odontonotus* the new genus differs by the shorter and more pilose antennæ, lack of the postocular tubercles, differently shaped pronotum, etc.

3. PARAPICTINUS OVATUS sp. nov.

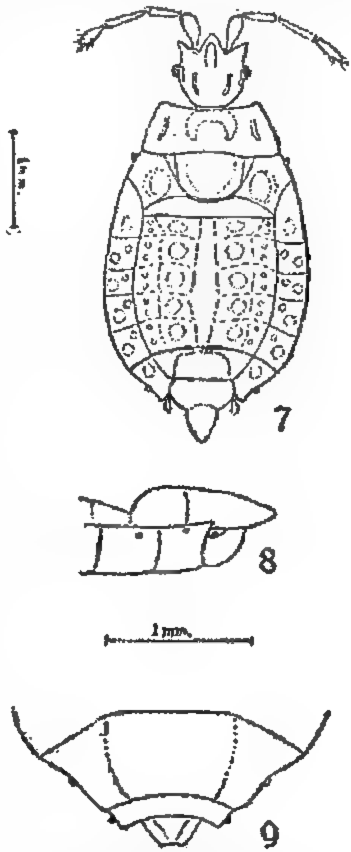
Male.—Head, less long than wide across the eyes (male, 20:23; female, 21:26); anterior process reaching to one-third of the first antennal joint; the proportions of the antennal joints (1–4) are: male, 12(6):9 (3.5):15(3):10(3.5); female, 13(6.5): 10(3.5) :16(3) :12 (4), the figures between brackets show the maximal width of the segment; the first joint is clavate, the second and third regularly widening towards the tip; the fourth fusiform. Fig. 7.

Pronotum less long on the median line than wide across the humeri (male 17:41; female, 17:46. Mesonotum less long on the median line than wide at the base (male, 15:25; female, 15:28).

Abdomen much longer than wide (male, 84:58; female, 80: 69); the hind tibia is as long as the head wide across the eyes (23:23). In the female the genital valves are as long as the oviduct. Figs. 8 and 9.

Color: uniformly reddish-brown, almost ferrugineous; rostrum and tarsi testaceous; eyes red.

Total length, male, 4.56; fe-



Parapictinus ovatus gen. nov., sp. nov.

FIG. 7. Male, seen from above.
8. Male, the apex of the abdomen seen from side.
9. Female, the apex of the abdomen seen from above.

male, 4.81 mm; width of the pronotum, male, 1.50; female, 1.62 mm; width of the abdomen, male, 2.12; female, 2.50 mm.

Holotype.—Male, India, Madura—Jos. Dubreuil coll.; deposited in the Hungarian National Museum, Budapest.

Allotype.—Female, collected with the holotype; in the same collection.

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THE OCCURRENCE IN INDONESIA OF TWO DISEASES, RHINOSCLEROMA AND BILHARZIASIS JAPONICA, WHOSE SPREAD IS ROOTED DEEP IN THE PAST

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ONE TEXT FIGURE

A. RHINOSCLEROMA

Rhinoscleroma is a chronic infectious disease of the nose, which generally begins with a feeling of itchiness, with a persistent cold and feeling of a blocked nose, and with occasional bleeding from the nose. Subsequently, the nose swells, becoming bigger and bigger and causing a characteristic change. It is an inflammation process which extends into the upper lip, and is caused by the *Rhinoscleroma bacillus* of von Frisch.

In Indonesia this disease is found in various parts of the archipelago where its spread, according to the hypothesis of Snijders and van Stein Callenfels, is rooted in ancient times, in an older substratum of the population which is closely connected with a primitive population stratum belonging to the Munda Kolaric tribe in India.

Since Snijders and collaborators (Stoll, Hamzah, Kouwenaar, Maasland, and Wolff) first observed this disease among the Battaks round the Toba Lake and on the Samosir Island, Snijders recommended an investigation into its occurrence among the Redjangs, Lebongs, Pasumahs, and Lampongs of Central and South Sumatra, in order to obtain evidence which might support his hypothesis, these groups all having affinity with the Battaks.

In this connection, the finding of this disease in the Pasumah lands by Surbek, and later by Kuilman, Kaiser, and Sardjito, greatly strengthens Snijders' hypothesis.

From the occurrence of rhinoscleroma on Bali, established by Noosten, Kirschner, and Vos, and from the fact that the old population stratum of Bali, like that of the Battaks and Pasumahs, was carrier of the megalithic culture, van Stein Callenfels takes the view in accordance with Snijders' hypothesis that the spread of the Munda Kolaric tribes in these areas

took place about 200 B.C.; for these pre-Indian tribes were also carriers of a megalithic culture. He expresses the opinion that in those districts where the remains of this culture are found, in the form of burial mounds, stone coffins, sarcophagi, and others, rhinoscleroma will also be found, as it is found in the Battak–Pasumah lands. Moreover, the occurrence of rhinoscleroma is to be expected in Besuki and on Sumbawa, Sumba, and Flores.

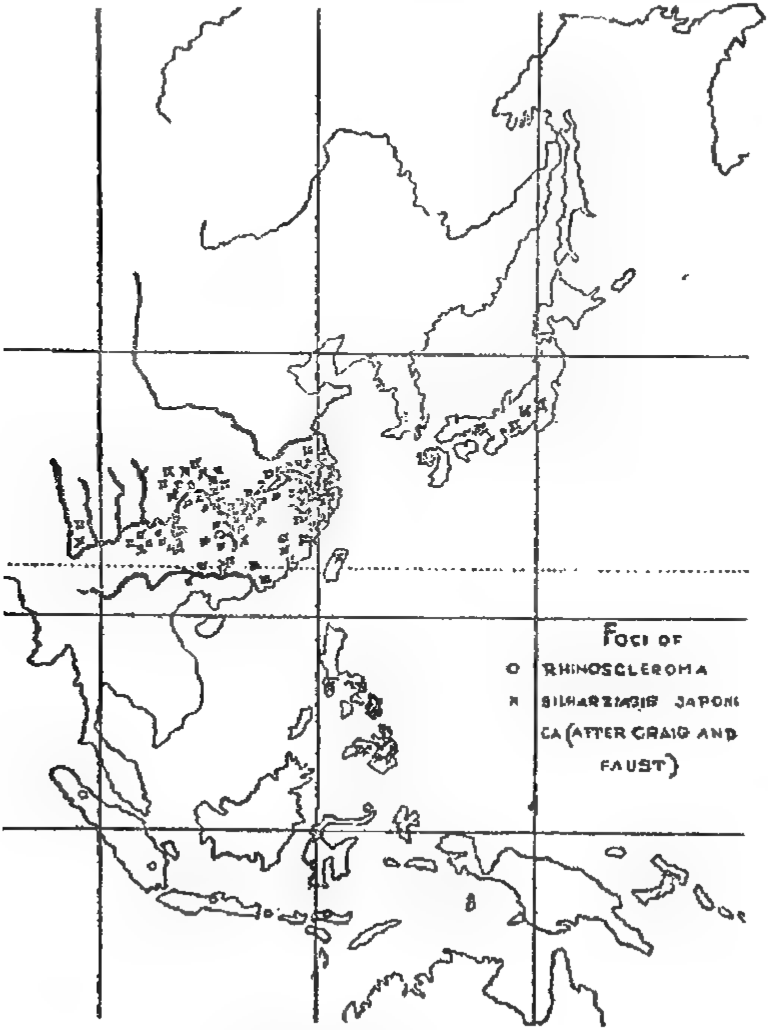

FIG. 1. Foci of *Rhinoscleroma* (o) and *Bilharziasis Japonica* (x) (After Craig and Faust.)

As van der Hoop has also discovered megaliths in Gunung Kidul (Jogjakarta) and in the regencies Tuban and Bodjonegoro, van Stein Callenfels' indication of the location Besuki should be extended to include Central and East Java.

In the course of the years cases of rhinoscleroma have been found in Java. The first indication of its occurrence on this island was its diagnosis by Pot Hofstede and Wolff in a Javanese female patient from Ngandjuk (Kediri). Other cases have come from the neighborhood of Ambarawa and Semarang (Moh. Djoehana, Mochter, Sardjito, Kuilman, Soerjatin), from Salatiga (Wiersema), from Gunung Kidul (Maasland), Tuban (Ramali), Surabaia, and Modjokerto (Müller, Engelen, Essed, and van Voorthuizen).

Adding these cases to those from the Battak–Pasumah lands and Bali, it will be noticed that in the distribution of rhinoscleroma the connecting links in Sumbawa and Sumba are still missing; the Flores link is represented by a few autochthonous cases (Haulussy, Sardjito).

It is worth mentioning that rhinoscleroma has also been found in Minahassa (Leimena, Sardjito, Oomen, Kirschner). Van Stein Callenfels more or less expected this disease to occur in Minahassa and in the West Toradja lands, although according to him there is a difference between the prehistoric way of burial in Celebes, where enormous stone urns are found, and in the southern chain of islands from Sumatra to Flores, where the remains of burial mounds, stone coffins, and sarcophagi are extant. The type of megalithic culture occurring in North and Central Celebes is further believed to be closely connected with that found in Indo-China.

Van der Hoop, however, is not entirely convinced that the hypothesis of Snijders and van Stein Callenfels is correct, because the present inhabitants of the Pasumah lands are not the descendant of the people who made the megaliths. (*S.*)

Rhinoscleroma was first diagnosed in Indonesia in 1918 by Stoll and Knebel and described in 1919 (Snijders and Stoll, Geneesk Tijdschr. v. Nederl.–Indie, vol. 59). This case was a woman from Asahan, North Sumatra, and it formed the impetus for an extensive investigation which was concentrated chiefly on Sumatra; only later were cases also found on Java, Bali, Flores, and Celebes.

The peculiar distribution of this remarkable disease has right from the start made it highly probable that it is somatically

connected with a certain old population stratum and that between the various foci a common relation may be sought, which is probably to be found in a prehistoric connection between the different population groups. As early as 1930, E. P. Snijders [Proc. Kon. Akad. Wetensch. Amsterdam 34 (1930) 1426–1435] pointed out that the distribution of this disease among the so-called Dravidian and pre-Dravidian population might point to such a connection: "All these arguments (linguistic, anthropological, and perhaps ethnological), point in the direction of an ancient connection between the Battak as rather pure representatives of a very old stratum of the people of the Malay Archipelago and a primitive population in India. And one is inclined to suggest the possibility that migrating parts of the same people in a stage of expansion, may have carried such diseases as leprosy and rhinoscleroma with them, from a common original home (p. 1433). I am inclined therefore to accept that rhinoscleroma is a very ancient disease clinging to a very old and primitve stratum of the population. I am quite aware that the argumentation is rather hypothetical, but this hypothesis gives more indications for further investigation into the anthropology of the Battak and the pre-Dravidian tribes in India. In the second place it may stimulate further research on the occurrence of scleroma in our Archipelago, especially among the rest of the primtive populations showing affinity to the 'Battak type' (p. 1434)." Snijders' hypothesis has indeed been very fruitful and van Stein Callenfels especially has argued a connection between this disease and the old megalithic culture. Although this has been disputed by van der Hoop, it seems to me that this theory—and let us not forget that it is a theory—can be defended.

However, I would like here to suggest another possibility, the theoretical nature of which I am also very conscious. In recent years it has appeared that in the Dongson culture of Vietnam, which exerted considerable influence on the Bronze Age in Indonesia, there are elements which point to a direct European influence. In a very well documented publication, Heine-Geldern has pointed out that in the 9th and 8th centuries B.C. European peoples reached Southern China, a migration which culminated in the capture of the city of Hao, the capital of the Western Chou, in 771 [R. Heine-Geldern, Das Tocharerproblem und die pontische Wanderung, Saeculum 2 (1951) 225]. In connection with these European elements, J. Kunst has

indicated in an absorbing article cultural-historical relations which exist in the musicological field between the music instruments and melodics of the Balkans and of Indonesia (Kont. Inst. v. d. Tropen, Amsterdam, Mededeling no. CIII, afd. Culturele en Physisiche Anthropologie no. 46). In a supplement issued a very short time ago, Mr. Kunst writes on p. 4: But the most astounding piece of evidence for musical parallelism between Indonesia, in this case Central Java, and the West Balkans has been stated recently by Dr. Yury Arbatsky. He found out that one of the so-called suluks, published by me in 1934 in my book "De Tookunst van Java" (reprinted in 1949 in "Music in Java"), namely the suluk *slendro patet nem wetah,* in its first and fourth phrases, is identical with the initial part of the diple melody he records from the nomadic Arumani tribe in Southern Yugoslavia, while the rest of that same *suluk*—and for that matter all other suluks—are built in exactly the same melodic trend.

These coincidences are too striking to be explicable by fortuitous circumstances.

We would not have mentioned this connection were it not for the fact that in Yugoslavia a few, very limited centers of rhinoscleroma are known.

My colleague at the University of Utrecht, Prof. Dr. J. J. A. van Egmond, very kindly informed me of this; and Mr. Gusic appears to have published articles on this question, which unfortunately were not available to me. One could therefore bear in mind the possibility that rhinoscleroma has been brought to South-east Asia and Indonesia during this old migration. It is also interesting that a case of rhinoscleroma is known from China; Garbar diagnosed this disease clinically in a 60-year old woman from the province of Hopei and he confirmed the diagnosis microscopically [Nat. Med. J. China **17** (1931) 701; quoted from: Snijders and Goslings, Zentralbl.f.Bakteriologie, Parasitenkunde und Infectionskrankheiten **132** (1934) 343–348].

Summarizing, we may say that in Indonesia and elsewhere rhinoscleroma because of its peculiar distribution gives the impression that it is connected with an old predisposed stratum of the population. For Indonesia a connection with foci of infection among the pre-Dravidian population of India is not improbable, but there is also the possibility that it has reached Indonesia along with the spread of the Dongson culture. (*v.K.*)

B. BILHARZIASIS (SCHISTOSOMIASIS) JAPONICA

Bilharziasis is a disease caused by worm (Bilharzia) which settle in the blood vessels of the abdominal and pelvic organs. The symptoms of the disease are largely a result of the accumulation of the ova laid by the female worms in the various organs which leads to chronic inflammations.

When the ova reach the capillaries in the intestines, they break through the capillary walls and settle in the wall of the intestines which then become inflamed with symptoms resembling those of dysentery, and blood and slime are passed in the faeces.

The ova can only develop further when they are eliminated in the faeces and reach water. There, the embryo comes out of the ovum, first swims round and infects a snail. If the snail is the right sort, the embryo develops in its body into a sporocyst in which daughter cysts develop. These daughter cysts in turn produce worm larvæ in their bodies, called cercariæ, which then leave the cyst and the body of the snail. The cercariæ swim around in the water until they get the opportunity to attack human beings or animals and then creep through the skin and reach the blood system. They nestle in the blood vessels of the abdomen and pelvis and become adults. The male worms copulate with the female ones, after which the latter lay their ova which cause the symptoms described above, and so on.

Bilharziasis japonica (Katsurada 1904) was first found in Japan, where there are five endemic foci. Subsequently, in the course of the years hundreds of foci have been found in China in the districts bordering on the Yangtze River, from the province of Szechuan to the coast. The most northerly province in which this worm disease occurs is Kiangsu, while in the southern province of Kwantung endemic foci are found along the Sikiang River. The disease is also supposed to occur in the Yuan Province along the Mekong River, as well as on Hainan Island.

According to Faust, in these territories there are millions of inhabitants suffering from *Schistosomiasis japonica*. On Taiwan Island this disease has been encountered in animals. The disease has also been met with in the Philippines where there are some dozens of foci. From the data published by the Public Health Research Laboratories, Division of Schistosomiasis, it appears that on Mindanao Island there are 27 epidemic

foci, on Leyte 17, on Samar 24, on Mindoro 2, and at the southeast tip of Luzon also 2.

Finally, in 1937 Brug and Tesch, and later (1939) Bonne and Sandground, confirmed the occurrence of an epidemic focus on Celebes in three small villages on the edge of the Lindu Lake up in the mountains 1,000 meters above sea-level.

The peculiar thing about this is that the disease occurs in inhabitants belonging to the Toradja, who live almost entirely isolated in villages, very seldom visited by people from other villages who come to buy or sell things.

This isolation can also be concluded from the slight infection with round- and hookworm, even in the village Antja (Brug, Tesch, Bonne, Sandground). In one of the three small villages infection with roundworm is entirely absent; while throughout Indonesia infection with hook- and roundworm is a perfectly normal phenomenon. On the other hand, infection with Bilharzia in other places in Indonesia has not been encountered among the autochthonous population.

Hoesin and van der Horst (1939), it is true, reported on a Chinese patient in Semarang (Java) suffering from *Bilharziasis japonica*; however, as this patient came from China, it may be concluded that this is not an autochthonous case but one imported from China.

Further, the isolated life of the population and the occurrence of oval red blood corpuscles in a large percentage of the inhabitants of the three villages indicate inbreeding (Bonne and Sandground).

Taking into consideration the isolated occurrence of *Bilharziasis japonica* in a population living in isolation on the edge of the Lindu Lake, it seems certain that the infection with the worms took place long ago.

How far back must this be supposed to have taken place? During the Dutch colonial period in Indonesia, the epidemic of *Bilharziasis japonica* must already have been present at the Lindu Lake, since during that time the traffic from the Philippines was not directed towards North Celebes. On the contrary, it has now appeared that the stream is rather of Indonesian people to the Philippines. And these Indonesian emigrants will certainly not be the people who have brought *Bilharziasis japonica* to the Philippines, as they do not come from the Bilharziasis district at the Lindu Lake, the inhabitants of which remained isolated.

The point in time when *Bilharziasis japonica* came to Celebes would then coincide with the arrival of immigrants from the infected areas and these all lie to the north. Nevertheless, the carriers could also have been animals, such as cows, dogs, and pigs, since these can be infected with the worms. The stream of people from the north to the south could then coincide with the arrival of the megalithic stone-urn culture in Celebes from Indo-China, possibly also from China via the Philippines.

Now the question is why *Bilharziasis japonica* has remained localized in these three villages on the Lindu Lake, while the spread of the migration from the north, as indicated by the distribution of the stone-urn culture found, is so great?

As we have seen above, the occurrence of Bilharziasis depends entirely on the presence of those snails or other molluscs which are suitable for the further development of the meracidia into cercariæ. These essential animals, intermediate hosts, must be present in the Lindu Lake area, where about 53 per cent of the inhabitants are infected with these worms, but these intermediate hosts are absent from other parts of Celebes.

That the search for these intermediate hosts of *Bilharziasis japonica* in the Lindu Lake district is very difficult, appears from the negative investigation of Bonne and Sandground, who especially for this search spent 11 days there and could not find what they were looking for. Because of this, these workers sent all the snail species they found to Bequaerd for determination. Of the 12 species, there is one, *Bulinus* (*Diggomostoma*) *sarasinorum* (Bollinger), which is related to *Blanfordia nosophora* (Robon), that can be looked upon as the carrier. However, this must be proved by experiment. (*S.*)

Bilharziasis is a worm disease which can occur in man and animals, but a fresh-water snail must function as intermediate host. This is essential and hence the spread of the disease is a biological problem rather than an anthropological one.

It must be borne in mind that in South Africa only very few fresh-water snails—I myself know of only one *Lymnæa* species—are known to act as an intermediate host. To what extent in different parts of Asia different fresh-water snails serve as intermediate hosts I cannot say. As it is always a question of a fresh-water species, spreading of this disease by sea does not seem likely.

The distribution of *Bilharziasis japonica* shows that its center lies in Southern China. From there, two branches run: one in the direction of Japan, while the other ends in Celebes.

The fossil mammalian fauna of Indonesia is derived from two areas. The oldest fauna—the Siva-malayan—comes originally from India and the somewhat younger one—the Sino-malayan—from Southern China. Several of the most characteristic animals of the Indonesian fauna are derived from this latter one: the orang utan, gibbons, tapir, Malayan bear, and clouded leopard. By which route these originally Chinese faunal elements reached Indonesia is at present difficult to reconstruct. Earlier, on the basis of the occurrence of the orang utan and other Sino-malayan forms on Borneo, I supposed that this fauna arrived in Indonesia via an old, temporary land bridge, over Taiwan and the Philippines [Pekin Nat. Hist. Bull. 13 (1938–39) 293]. However, this has been disputed by Colbert and Weidenreich who suggest that the fauna in question reached Indonesia via Malacca.

Neither of these suppositions has been proved; the fossil fauna of the Philippines, in which the *Stegodon* and other extinct elephants occur, is not yet sufficiently well known to make a decision as to whether this fauna corresponds more closely with the Taiwan fauna situated to the north or with the Indonesian fauna to the south.

It is striking that Bilharziasis has spread precisely along this old, hypothetical land bridge, the existence of which I have previously been led to suppose. In connection with this, the search for the fresh-water snail which functions as intermediate host may perhaps in the future shed light on the question. (*v.K.*)

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